NATURE

SATURDAY, AUGUST 20, 1927.

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3016, Vol. 120]

Safety in Mines.[1]

IT is satisfactory to note from the Fifth Annual Report of the Safety in Mines Research Board, just issued, that researches of an important character are being actively pursued, and especially that the Board appears to be taking a wider view of its duties than was at one time the case. It has been pointed out more than once that the tendency of the Research Board was to trust too implicitly to laboratory investigations, and that as an almost necessary consequence many of the researches were confined to chemical or physico-chemical problems. What is particularly needed to-day is investigation of mechanical problems. These are of such a nature that their proper investigation can be carried out only in the pit, and laboratory work can do little more than give an indication of the direction in which the researches would need to be prosecuted.

The most fertile cause of underground accidents is still, as it has been for many years, that occasioned by falls of ground; an investigation, sufficiently complete and searching to enable suitable remedies to be suggested, is necessarily a lengthy and wearisome one, and one which can only be carried out underground. It is, therefore, gratifying to observe that investigations of this type are being actively pursued. The results obtained by the dynamometer-prop, the object of which is to measure the actual roof pressures experienced in the mine, will be looked forward to with great interest, though every experienced miner knows that it is not the amount of pressure only which matters; a roof which weighs heavily, but can be so controlled as to take advantage of that very weighting for the purposes of coal getting, is likely to be a source of much less danger than the roof which presses less heavily, but is apt to break up without warning.

Among the reports of results of investigations issued during the course of the year was an exceedingly valuable one on the East Midland Coalfield, in which the results obtained by steel props were recorded and their more general adoption, at any rate on an experimental scale, was advocated. Such props are attracting considerable attention, and it is to be hoped that the Safety in Mines Research Board will continue to investigate the respective advantages and drawbacks of the different types of props which are being put on

[1] Mines Department. Fifth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1926. Pp. 55. (London: H.M. Stationery Office.) 9*d*. net.

the market. It may be noted that the Board has had tests carried out on quartered props, which show that these props are as strong as round props of the same sectional area. It may be doubted whether it was worth while carrying out these tests, seeing that the subject has been fully dealt with in Germany, and the German reports show exactly the same conclusion as has been reached in Great Britain (see *Glückauf*, 1926, p. 1409). It is, however, some satisfaction to find that the results which have been obtained by the British and German investigators have led to identical conclusions.

Another subject on which the Safety in Mines Research Board is initiating an investigation, is wire ropes, and this may be described as an investigation of first-rate importance. It is true that colliery accidents due to the failure of wire ropes are exceedingly rare, and that they stand almost at the opposite end of the scale to that which accidents from falls of ground occupy. Nevertheless, it may fairly be said that there is no article in common everyday use about which our ignorance is so profound as is the case with the wire rope, and any information concerning wire ropes will be eagerly welcomed. No fault can be found with the objects of the wire rope committee, namely, to discover means of prolonging the life of the rope and of foretelling probabilities of failure; but the method which the committee proposes to adopt, namely, to examine samples cut off from the ends of winding ropes when re-capping takes place, is decidedly open to objection.

Whilst it is a fact that winding ropes very rarely fail at the cappings, it is nevertheless certain that the end of the rope where it enters the capping is liable to much more severe corrosion than any other part of the rope; where ropes are capped by running in white metal, local galvanic action may be expected, and, in any event, this is the point at which acid water, however produced, is most liable to accumulate. On the other hand, the end of the rope is never exposed to bending stresses, which affect every other portion of the rope as it passes over the pit-head pulleys and round the winding drum. These stresses, with the consequent alternation of stress, are bound to have a more or less injurious effect upon the rope, and this effect will be entirely missed by investigations confined to the end of the winding rope. There is no doubt that winding and haulage ropes constitute a vast field for investigation, and it is highly satisfactory to learn that a systematic attack upon these problems has now been commenced.

Among other researches of importance is one upon the improvement of the lighting efficiency of safety lamps, both electric and flame lamps, and the report certainly suggests that a very considerable measure of success has already been attained. The publication of the full account of this work will be looked forward to with much interest. Researches upon coal dust and firedamp explosions and upon mining explosives are, of course, being steadily continued. Naturally, this aspect of the work is very closely connected with operations at the Buxton Research Station, the official opening of which took place only a few weeks ago. There is no doubt that the geographical position of this station is an immense improvement upon Eskmeals, and the experience gained by the latter station will no doubt have been fully utilised in the design of the new station, so that this may be fully equal to all the work required of it, both as a testing station and as a research station.

Important results may be expected from the electrical researches in progress, the ultimate object of which is to obtain electrical appliances which shall be absolutely safe for use in underground work even in fiery pits. Other subjects which are briefly dealt with in this report are researches on the spontaneous combustion of coal and the investigation of certain defects in mine rescue apparatus, which have been found in practice to cause inconvenience; the report indicates that remedies for these defects will in all probability be forthcoming as the result of these researches. There is a brief reference to the constitution and the work done by the Health Advisory Committee, which has now been brought into closer relationship with the Safety in Mines Research Board by the appointment of Sir Edward Troup as chairman of both.

The report contains two interesting appendices, one being a programme of the researches of the Board which are either in progress or under consideration, and the second a report on the co-operative researches that are being carried on jointly by the United States Bureau of Mines and the Safety in Mines Research Board. It is sincerely to be hoped that this scheme of co-operation will be further extended until it embraces all the researches carried on in all the coal-mining countries of the world upon objects identical with those of the British Safety in Mines Research Board.

Forestry in India.

The Forests of India. By Prof. E. P. Stebbing. In 3 vols. Vol. 3 : The Progress of Conservancy and the Development of Research in Forestry, 1901–1925 ; including Brief Reviews of the Progress of Conservancy in the several Presidencies and Provinces between 1871–1900. Pp. xix + 705 + 122 plates. (London : John Lane, The Bodley Head, Ltd., 1926.) 42*s.* net.

THE third and final volume of " The Forests of India " is divided into two parts, the first of which deals with the period 1871–1900, and contains brief descriptions of the main features which affected progress in forestry in the different provinces. The period covered by this section of the book corresponds more or less to a definite stage in the development of Indian forestry. It is the period of reservation and demarcation of an area to be permanently maintained under forest.

In reading Part 1 of this volume it is important to realise that India is not homogeneous. Apart from differences in geographical, topographical, and climatic conditions, which result in different forest types and therefore different forest values, the provinces themselves were in varying stages of development and had different histories. Different forms of land tenure existed, and the people differed in local customs and methods of cultivation. Prof. Stebbing devotes a separate chapter to each province and gives us an outline of the difficulties to be overcome.

In all countries the history of progress in forestry is the history of the education of the people, and in India a second factor existed, the need for educating the civil authorities. All through we find instances where the latter were antagonistic, or at least unsympathetic, to the Forest Department, and although this may appear to be an unusual feature, it has its explanation in what is described as " a supersensitiveness on the part of the civil authorities on the question of the rights of property " and their reluctance to interfere unnecessarily with local customs. Examples are quoted where this attitude was undoubtedly carried to extremes ; but considering the past history of India, this feature was largely unavoidable and its delaying effect may not have been unduly great.

The factors which were primarily responsible for progress were economics, and examples are to be found in most provinces. The visible effects of the destruction of forests on the water supply and erosion, the increasing demand for and the diminishing supply of cheap fuel and timber, were the things which finally convinced local governments of the need for defining a policy with reference to forest areas.

During the thirty years under review, India was fortunate in having at its disposal the services of three very able Inspectors - General, Brandis, Schlich, and Ribbentrop. Prof. Stebbing quotes largely from the reports of these officers, particularly those of Brandis, whose energy and driving powers were amazing.

It is impossible to deal with all the aspects of the developments which are mentioned in Prof. Stebbing's book ; but perhaps the most striking fact is the dependence of progress on the close co-operation between the Chief Forest Officer and the local government on one hand, and on the maintenance of friendly relations between the Divisional Forest Officer and the local inhabitants on the other. Where these two conditions exist, the progress of education goes on smoothly and with the least delay.

In other branches of forestry developments were also taking place. In Burma, the United Provinces, and the hill divisions of the Punjab, forests were being worked under regular ' working plans,' and in Ajmer-Merwara and the plains of the Punjab we find the first attempts to re-afforest areas, where the destruction of forests had proceeded too far.

By the end of the last century the progress was such that the area under forest compared favourably with that in other countries in Europe and elsewhere, the general lines of forest policy had been definitely laid down in all provinces, and the forest service was firmly established. Part 1 of this volume is a striking tribute to the first three Inspectors-General.

In Part 2, Prof. Stebbing deals with developments between 1901 and 1925, and in the opening chapter he gives a short review on the administration of India during this period. In the following chapter, which is devoted to forest administration, he points out how sylviculture, working plans, utilisation, and research now take precedence over reservation, protection, and forest legislation. On p. 262, while acknowledging the debt owed to the first three German Inspectors-General, he would have us believe that the very rapid progress in recent years dates from the change to English Inspectors-General and, in particular, from the inauguration of the Imperial Research Institute in 1906. If this is to imply that the formation of a research branch is the cause of the rapid development, this is an opinion which will not be accepted by many

forest officers in India, and it is preferable to continue to look upon the progress made as a natural evolution governed by economic factors, such as the growth of Indian industries and the stimulus of the War.

The figures on p. 622 in the chapter on yield and revenue for imports of railway sleepers, which increased in value from less than Rs30,000 in 1919 to nearly Rs40,00,000 in 1923, speak for themselves. The sanction of the large sum of money for the new Research Institute was feasible only on account of the economic need for expansion in research, particularly in the branch of forest economy. We find the same rapd advance in other branches, sylviculture, working plans, and utilisation, the splitting-up of territorial charges and increases in staff, due not to forest research but to the forests becoming economically more important to India.

The chapter on forest research is of particular interest and well illustrated by photographs, which give some idea of the scale on which the new Research Institute is equipped. The author also deals with advances in sylviculture, afforestation, fire-protection, working plans, and exploitation, and in Chap. xiii. discusses forest education and the training of probationers for the Indian Forest Services. In this chapter he expresses opinions which will not find favour with all, particularly on the subject of "training under subsidised German Forest Officers" and on the value of tours on the continent of Europe.

On the question of Indianisation and the future training of Indian probationers, now 75 per cent. of the annual recruitment at Dehra Dun, Prof. Stebbing appears pessimistic. In Chapter xvi., on sylviculture, he admits that "at the present day work on as high a plane as anything on the continent of Europe is to be seen in India." He proceeds to qualify this statement by "the proviso that these methods have been so far only applied to a comparatively small area," and gives it as his opinion that "India is not yet in a position to afford as valuable a training ground as exists in Europe, because with few exceptions no Indian forest has yet passed through a whole rotation." Some of those who have had experience in teaching forestry at Dehra Dun and have also re-visited continental forests, will be inclined to think that Prof. Stebbing has been too emphatic on this point. Whatever views are, however, held on this point, it is now the accepted policy of Government to train three-quarters of the future probationers in India, to be followed by a visit to the continent after three years in a division, and, as is pointed out, it rests with those responsible for the selection of the right type of probationer and for the control of the new training centre, whether the future is to be retrogressive or otherwise.

Prof. Stebbing's book contains a vast amount of information on all aspects of Indian forestry and is essentially a historical record of a department of which India may justly feel proud. It is as a history rather than as a critical work that the book is of value.

Little need be said on the arrangement of the book or the subject matter. The author has had to deal with a large subject, covering a period of time during which conditions were changing very rapidly. He must have experienced considerable difficulty in selecting from the mass of official reports and papers those which could most suitably be included to illustrate half a century of forest progress.

Prof. Stebbing is to be congratulated on having compiled a history, which gives so many concrete facts about one of the departments the activities of which are carried on far from the public eye, and on the excellent photographs with which the book is illustrated. In his preface the author expresses the hope that he has been able to show that the Indian Service can take rank with some of the most organised forest services in Europe, and those who read his book will agree that he has achieved his object.

C. E. SIMMONS.

Band Spectra.

Bulletin of the National Research Council. Vol. 11, Part 3. No. 57: *Molecular Spectra in Gases.* Report of the Committee on Radiation in Gases. Pp. 358. (Washington, D.C.: National Academy of Sciences, 1926.) 4 dollars.

ONE of the most formidable obstacles to the progress of science at the present day is the manner in which it is progressing. The continuous increase in the number of research workers and in the scope of their investigations cannot be a source of unalloyed satisfaction to the earnest seeker after knowledge, who before ever he begins a research must delve long and laboriously in the files of countless periodicals in order to discover just where he should begin. There are abstracts, it is true, but they are seldom adequate; in practice one finds them chiefly useful in facilitating reference to the papers really relevant to one's purpose. From this point of view they are often extremely valuable, but from time to time in the develop-

ment of a subject the need becomes urgent of a pause to review the results obtained and to consolidate the advances made. It is a difficult task, demanding much labour, critical judgment, and breadth of vision. A mere compilation is not enough, for in the study and co-ordination of so many researches numerous problems are bound to arise which call for immediate investigation with the object of removing discrepancies or establishing generalisations. Yet the compiler must exercise a nice discrimination in embarking on such researches, for publication cannot be long delayed if the work is to be up-to-date and not unduly littered with "notes added in proof." Obviously, then, it is not a task to be undertaken lightly; but on the other hand, if well done, it should be of inestimable value, not only to the worker in the particular region surveyed but also to those in neighbouring fields as well.

The time was undoubtedly ripe for such a review of band spectra. In the last ten years a rich harvest of results has been reaped, but scarcely garnered, and the phenomena in question are of such a complex character that no survey could be adequate unless planned on a rather considerable scale. For this reason the National Research Council did wisely in entrusting the task to a committee rather than to an individual. In the present case the consequent loss of homogeneity is certainly outweighed by the gain in authoritativeness. There are five contributors: two of them (Kemble and Page) deal with the theoretical side of the subject, and the other three (Colby, Birge, and Loomis) mainly with the experimental, under the headings of infra-red absorption bands, electronic bands, the isotope effect, and fluorescent band spectra.

The second of these sections is by far the largest, comprising in fact more than half the book. This is natural enough, since bands of the electronic type (*i.e.* involving changes of electron configuration) are both the most complex in structure and the most accessible to investigation. Prof. Birge's task must have been an exceedingly difficult one, particularly in view of the rapid progress which has recently been made in the interpretation of optical bands, but he would probably be far from regretting the undertaking, for the researches which presented themselves in the course of the work have had some notable results. For example, they led him to the recognition of the essential similarity between molecular and atomic electron transitions, a conclusion of great importance and fruitfulness. Congratulations are due to him upon an extremely valuable piece of work.

The other sections also contain much that is interesting and suggestive. In the account of infra-red absorption bands (Colby) one would have been grateful for a little more information concerning the far infra-red region, so full of difficulty and promise. The section on fluorescent band spectra (Loomis) deals actually with that of iodine only, but the facts described are certainly of sufficient interest to justify the allocation of a whole chapter to them. It seems to the writer that the discussion here is not quite so easily followed as could be wished, but this may be a merely personal difficulty. Chapter v., also by Loomis, is a very useful account of the isotope effects occurring in band spectra. Up to the present these observations have served mainly to confirm band spectrum theory, the isotopic constitution of the elements being already well established, but it is not improbable that they may find wider applications in the future.

The final chapter, by Prof. Kemble, is a masterly survey of certain theoretical aspects of the subject. The account of Hund's recent work on bands will be found particularly valuable, and the section on the Zeeman effect also calls for special mention, providing as it does a basis for discussion and extension of the rather perplexing results already obtained in this connexion.

One of the most valuable features of the Report is the systematic notation scheme which has been used throughout. Progress would be greatly facilitated if this were universally adopted by writers on the subject. The volume is admirably produced, and misprints are very few. There is a reference to the "first measurement" of the MgH band λ5211 as by Watson and Rudnick (instead of by Fowler), but this may be nothing more than a slight ambiguity of construction. The bibliography, whilst professedly incomplete, is very extensive, but it is a great pity that no index is provided.

Sex Physiology for the Laity.

Sex in Man and Animals. By John R. Baker. Pp. xvi + 175 + 4 plates. (London: George Routledge and Sons, Ltd., 1926.) 7*s.* 6*d.* net.

THE need for an inexpensive book on sex addressed to the interested layman and written by a trained biologist has long been recognised. It is true that there are many popular books dealing with this subject, written during recent years by sincere enthusiasts whose chief claim to authorship would appear to be an irresistible yearning to help their fellow-women;

but the extent of the ignorance of established biological fact and the easy disregard of scientific method exhibited by these authors have forced the professional and responsible biologist to accept the task of democratising the knowledge that he possesses. Biology, and especially sex-physiology, is the field in which any and every one exercises his or her opinions. The chemist or physicist can speak of his science without interruption, for in it there still is magic, but let the sex-physiologist speak and his voice is at once drowned in violent controversy. Impressionistic, anecdotal, uncritical doctrine, born of desire and supported by insufficient and inexact observation, denies the logical inferences of dispassionate experimentation, and the people, eager for information and for guidance, are led along the road that leads to disappointment and disillusionment, while the eyes of many still remain blinded by hope.

To the general public sex is still, in spite of the abundant fruits of the last five-and-twenty years of most profitable research, one of the great mysteries. It is high time that the layman should be told that, though as yet all concerning the details of the processes of sex-determination and sex-differentiation is not known, it is the case that the salient and significant features of these processes are already apprehended. The study of the chromosomes and of the internal secretions has revealed the precision and the wonder of the mechanisms concerned, and the advance in knowledge concerning sex has been such that already it is possible to control the expression of certain of its aspects. It is desirable that this knowledge should be placed before the public, whose lives are continually affected in one way or another by one or more of the various manifestations of sexuality; it is desirable that there should be made available a fair statement of current scientific opinion concerning sex; it was high time that some professional biologist, well equipped for the task and with a *flair* for interpreting scientific terminology into language readily understood by the man in the street and the woman in the home, should place his services at the disposal of those who desire to learn.

Mr. J. R. Baker, provoked by the manifest need for such an exposition, has discussed the facts adequately, frankly, and rationally. In his book, addressed to students of biology and of medicine, the subject matter is well chosen and well arranged and the language is simple. It is written especially for those who look to others for their creed. Among the well-sustained conclusions of many authorities are dispersed the personal opinions of the author concerning not only the biological but also the anthropological, psychological, and sociological aspects of his subject, and it is not always easy to distinguish between generally accepted facts and reasonable but personal point of view concerning the possible implication of these facts in relation to human affairs. The author writes with courage and with competence as one willing to accept the responsibilities of leadership and as one who sees the goal of human endeavour. In his praiseworthy attempt to democratise scientific knowledge he has deliberately avoided meticulous accuracy and any profound consideration of elaborate detail, and so the real significance of the general principles of the subject is not obscured.

Since his teaching cannot be reconciled with the preferences and prejudices of the multitude who dedicate their activities to the dissemination of their own speculative but attractive theories and methods of controlling sex, the author must not expect that his teaching will be as widely followed as it deserves to be. He has, however, the satisfaction of having written a book that must be of great value to any one who, being eager to hear of what is known and of what is reasonable, seeks to sit at the feet of somebody who himself has contributed quite notably to our knowledge of sex.

F. A. E. CREW.

A Contribution of Science to Religion.

Religion in the Making: Lowell Lectures, 1926. By Prof. Alfred North Whitehead. Pp. 160. (Cambridge: At the University Press, 1926.) 6*s.* net.

IN the preface to this volume the author refers to the four lectures on religion delivered in King's Chapel, Boston, during February 1926, in which the train of thought which was applied to science in his Lowell Lectures of the previous year ("Science and the Modern World") is here applied to religion. It is stimulating to read this book from the pen of one who can speak with such authority and experience in the realms of mathematics, science, and philosophy.

The work is divided into four chapters, the first of which, "Religion in History," begins with the definition of religion: the theme developed is that religion is solitariness.

"Collective enthusiasms, revivals, institutions, churches, rituals, bibles, codes of behaviour, are the trappings of religion, its passing forms. They may be useful, or harmful; they may be authorita-

tively ordained, or merely temporary expedients. But the end of religion is beyond all this. . . . What should emerge from religion is individual worth of character."

The emergence of religion is traced and four factors are exhibited—ritual, emotion, belief, rationalisation. "The bible is by far the most complete account of the coming of rationalism into religion," and the effect of travelling and trading facilities eventually produce a world-consciousness. The same growth can in essence be traced in India and China. In the last section of this chapter rational religion is described as the wider conscious reaction of men to the universe in which they find themselves. Generality is the salt of religion.

The dogmas of such religions as Christianity and Buddhism, especially with regard to the problem of evil, form the subject of the second chapter, "Religion and Dogma." The contrast is seen in Buddhism as a metaphysic generating a religion, whereas Christianity has always been a religion seeking a metaphysic. The life of Christ is not an exhibition of overruling power; its glory is for those who can discern it and not for the world. Its power lies in its absence of force. It has the decisiveness of a supreme ideal, and that is why the history of the world divides at this point of time. There are three concepts on which religion is founded, namely, that of the value of an individual for itself, that of the value of the diverse individuals of the world for each other, and lastly, that of the value of the objective world. To the query of value and the attainment of light, comes the answer that religion is world-loyalty. In the greatest of all religious dogmas—What do you mean by 'God'?—there are three simple renderings of this concept: the first that of the eastern Asiatic concept of an impersonal order, and then the Semitic concept of a definite personal entity, and lastly the pantheistic concept. If the modern world is to find God, it must find Him through love and not through fear; the author emphasises the help of St. John in this direction, rather than the God of vengeance.

The third chapter is metaphysical and leads up to God and the moral order: value and the purpose of God, body, and mind. The fact of the instability of evil is the moral order in the world. The order of the world is no accident; value, beauty, zest of life, peace of life, and the mastery of evil are all bound together, and the religious insight is the grasp of this truth in relation to the completed ideal of harmony, which is God.

Finally, Prof. Whitehead investigates the application to religion of a contrast between 'dogmatic' and 'empiric.' Again, the divergence of the two traditions of Buddhism and Christianity is traced, with a reference to absolute idealism as a reaction for Buddhist metaphysics on the part of Western mentality. Meanwhile science had appeared as a third organised system of thought, and both Christianity and Buddhism, having unduly sheltered themselves from each other, were unable to reveal the requisite flexibility of adaptation demanded by the rise of science. Such men as Origen and Erasmus in the Christian Church have, at any rate, recognised the central importance of this adaptability. The book closes with references to the nature of God as the complete conceptual realisation of the realm of ideal forms. The kingdom of heaven is God. God in the world is the perpetual vision of the road which leads to the deeper realities, God upon Whose wisdom all forms of order depend.

It is certainly to be hoped that Prof. Whitehead's work will be carefully studied by all who mould current theological opinion. H. D. A.

Our Bookshelf.

Metallurgy of Cast Iron: a Complete Treatise for Engineers, Foundrymen, and Students. By J. E. Hurst. (The Specialists' Series.) Pp. xvi+311. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 15*s*. net.

CAST iron has a very limited literature in comparison with steel, and it is only lately that any considerable attention has been given to its scientific study, although isolated workers have attempted from time to time to elucidate its complex problems. The author of this little book has an extensive practical experience of the subject, and has been responsible for several improvements in technical practice. He therefore speaks with authority on matters concerning the foundry. Cupola and moulding practice are not dealt with, and the book is devoted to the chemical and physical characteristics of cast iron in their relation to its use in the foundry. The chemistry is not always correct, but the errors will not mislead the practical reader to any serious extent. The vexed question of the relations between sulphur and manganese deserves more detailed consideration than it receives here, but it is a point on which an author scarcely dares to be dogmatic.

In view of the author's personal experience, it is surprising that so little is said of casting in permanent moulds, especially by the centrifugal process, whilst one also misses a discussion of the various methods now adopted, mainly on the suggestion of German inventors, for obtaining strong and tough irons by heating the mould or by using high casting temperatures, after controlling the chemical composition according to definite

rules. Maurer's diagram is open to objection because it does not take into account the varying thickness of castings, but it is a useful guide, and can be modified to give graphical methods of calculating compositions which have proved to be of real use in the foundry, so that it should have been mentioned. The statement concerning viscosity on p. 275 is incorrect, and is based on a misunderstanding. The work of Wimmer on the viscosity of molten cast iron was perhaps published too late for inclusion. C. H. D.

Die Massanalyse. Von Dr. J. M. Kolthoff. Unter Mitwirkung von Dr. H. Menzel. Erster Teil: *Die theoretischen Grundlagen der Massanalyse.* Pp. xii + 254. (Berlin: Julius Springer, 1927.) 10·50 gold marks.

DR. KOLTHOFF, of Utrecht, has undertaken in an able manner the task of producing a readable volume dealing with the fundamental principles of volumetric analysis from the point of view of the ionic hypothesis and the law of mass action. The justification of such a work is that by the application of these principles new methods of analysis may sometimes be deduced by direct rather than by empirical reasoning. This is particularly true of reactions involving neutralisation, precipitation, and the formation of complex ions, with which the first part of the book deals. Oxidation processes, on the other hand, are more elusive, since the range of indicators which will detect a definite oxidation-potential is at present somewhat restricted. Attention is directed to the promising results, published by W. M. Clark and others in the U.S. Public Health Reports, on the use of indigosulphonic acids and indophenols. In many cases, however, the disturbing influence of catalysts or of induced by-reactions has to be taken into account.

Special attention is also devoted to the theory of indicators, to titration errors and to adsorption phenomena, and a chapter deals with the application of volumetric analysis to organic chemistry. The author is mainly concerned with titrations requiring indicators, but potentiometric methods are briefly described in the last chapter. Tables of useful constants form an appendix and there are numerous references to modern literature in the foot-notes. The German text has been produced in collaboration with Dr. Menzel, and a later volume on the practical application of the methods is promised.

Kings of the Hittites. By Dr. D. G. Hogarth. (The British Academy: The Schweich Lectures, 1924.) Pp. viii + 67. (London: Oxford University Press, 1926.) 6*s*. net.

DR. HOGARTH has published his Schweich Lectures for 1924 practically in the form in which they were delivered before the British Academy, his reason being that owing to the still imperfectly published state of the results of excavation, the time has not yet come for fuller treatment. In this he has been wise, for, well argued as are his conclusions, his method of treatment in lecture form serves to emphasise their still extremely tentative character. His kings of the Hittites are those of the Biblical narrative, the rulers of the southern Hittites, to whom reference occurs in the Chronicles of the historic age as holders of States to the north of Palestine in the earlier period of the Jewish monarchy. His purpose has been to illustrate their civilisation and to try to discover their origin and racial character.

The evidence upon which Dr. Hogarth draws is that imperfectly published, as already stated, from the sites of Zenjirli, Sakjegeuzi, and Carchemish. In discussing the connexion with the Cappadocian Hittite, Dr. Hogarth is inclined to see a common origin rather than a direct connexion. For this origin he suggests we should look towards the east at the early part of the second millennium B.C. with a leaning towards its identification with the Mitanni. Dr. Hogarth by no means minimises our lack of knowledge of this people, and his readers will fully agree as to the need for exploration of the northern area of Mesopotamia, in which their influence was dominant, before we are likely to deal with any approach to finality in this and the other problems which he discusses.

La technique photographique. Par L.-P. Clerc. Préface de Ch. Fabry. In 2 vols. Tome 1. Pp. xx + 458 + 2 planches. (Paris: Paul Montel, 1926.) 100 francs les deux vols.

DURING the last decade or two there have been notable additions to our knowledge of the fundamental facts upon which the practice of photography depends, and some of the problems of twenty years ago have been at least partly solved. Added to this, new needs have arisen, and these have led to the production of new apparatus and new methods of working. It follows that for some few years the want of a modern text-book has been acutely felt by students and their teachers, and it is exactly this want that has been met by M. Clerc. We hope that it will not be very long before a similar text-book is produced in English. M. Clerc knows well, from his experience as a teacher, what the student of photography needs, and he has used his knowledge of this and of the subject with great discretion. He has not neglected old facts to make room for new, or so shortly summarised the new as to make the references to them unintelligible. The illustrations are good and well chosen—not from manufacturers' catalogues. The subjects dealt with in the first volume are light and vision, and the apparatus, materials, and processes used in making negatives, leaving the consideration of printing methods for the second volume. C. J.

Reptiles and Amphibians: their Habits and Adaptations. By Thomas Barbour. Pp. xx + 125 + 52 plates. (London: George G. Harrap and Co., Ltd., n.d.) 10*s*. 6*d*. net.

THIS is one of the few books dealing with a neglected branch of natural history, and, though it aims chiefly at interesting a wider public in these much misunderstood animals and is consequently rather of the 'semi-popular' type, it will form a welcome addition to the library of the more serious student.

As its author candidly admits, the book lacks continuity, but gives a very readable, though necessarily incomplete, account of the principal morphological, physiological, and habitudinal modifications which the recent reptiles and amphibians have undergone. The whole work is profusely illustrated and, though errors are not entirely absent, the text is essentially sound; one can only therefore regret the occurrence of such a sentence as this: "——and marvellous developments have been attained, though by infinitely slow degrees, to enable these fascinating creatures [snakes] the better to fit into the environmental niche pointed out to each plastic form by the inevitable finger of evolution." It would be interesting to know whether Dr. Barbour really believes that the evolutionary changes an animal has undergone determine the environment it occupies. There is no index.

Feuchtigkeitsmessung. Von Dr. Hermann Bongards. Pp. vii + 322 + 2 Tafeln. (München und Berlin: R. Oldenbourg, 1926.) 17 gold marks.

THE measurement of the humidity of the air as effected both at an ordinary climatic station and by sounding balloons is not very satisfactory; different methods of estimating evaporation also give different results. So this systematic account of the various processes of measurement that have been developed is of real value not only in a meteorological department, but also to such commercial enterprises as control the quantity of moisture in the air of their factories.

After a lucid statement of the physics of gases and vapours, Dr. Bongards groups the processes of measuring humidity according as they are dependent on (*a*) absorption, (*b*) saturation, (*c*) partial condensation of the water vapour, (*d*) evaporation, and (*e*) the hygroscopic properties of bodies; he also briefly describes the effect of water vapour on the optical, electrical, and other physical properties of bodies. The comprehensive nature of the treatment may be inferred from the fact that there are 126 diagrams or illustrations of instruments; where advisable their theory is fully discussed and practical advice in their handling is offered. The necessary tables are provided, and full indexes make the volume easy of reference.

Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom: being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1926 and in certain Selected Publications issued in 1927. Vol. 5 (1926). Pp. 273. (London: H. M. Stationery Office, 1927.) 1*s.* net.

THE charge can no longer be made against Government departments that official statistics are hidden in departmental publications of which only the initiated are aware. This valuable volume, issued at a nominal price, is a complete guide to all official statistics published during the past year. It consists of two parts, a subject index and a list of publications arranged under the headings of the departments of issue. The subject index is full and well supplied with cross references. No worker in need of Government statistics should have any difficulty in tracing what is available by the help of this volume. It is a work of reference which deserves a wide circulation.

Données numériques de biologie et de physiologie et chimie végétales. Rédigées par Prof. E. F. Terroine et par Prof. H. Colin. (Tables annuelles de constantes et données numériques, Extrait du Volume 5, années 1917 à 1922). Pp. viii + 1537–1675. (Paris: Gauthier-Villars et Cie; Cambridge: At the University Press; Chicago, Ill.: University of Chicago Press, 1926.) 56 francs.

THE present section of this work deals with animal and plant physiology and biochemistry, and consists of tables extracted from papers published during the years 1917–1922, arranged under appropriate headings. Very varied information may be found within its pages. Thus weight-relationships, the chemical composition of organisms and their organs and tissue fluids, and the toxicities of drugs are all included. The greater part deals with plant physiology and chemistry, but data on enzymes and the biochemistry of vegetable products are frequently of use to animal physiologists. The data are given in French, but the table of contents is also given in English, German, and Italian. They are compiled from a selected list of about sixty different journals. The work should be useful for quick reference on any particular subject.

Vorlesungen über landwirtschaftliche Bakteriologie. Von Prof. Dr. F. Lohnis. Zweite, neubearbeitete Auflage. Pp. viii + 400 + 10 Tafeln. (Berlin: Gebrüder Borntraeger, 1926.) 22·50 gold marks.

THE first edition of this book was published in 1913 and was regarded as a landmark in the development of agricultural bacteriology. Since that date, although the subject has advanced rapidly, no further edition has appeared, if the small book written in English in collaboration with Prof. Fred of Wisconsin be excepted. The present edition will therefore be welcomed by agricultural investigators, for though retaining the general form of presentation adopted for the original edition, the general results of the last fifteen years' research are incorporated, making the book essentially a modern text-book.

Practical Physics. By T. G. Bedford. Pp. x + 425. (London: Longmans, Green and Co., Ltd., 1926.) 10*s.* 6*d.* net.

THE course of practical physics described in this book, which is based on manuscript notes used in the Cavendish Laboratory, covers the first year's work of the average student preparing for Part 1 of the Natural Sciences Tripos. Most of the experiments are simpler than those performed in the following year, which are unfortunately only partially described in Dr. Searle's text-books. The short introductory section contains valuable general instructions, and the book will be particularly valued by those teachers of physics who have had the privilege of passing through Mr. Bedford's class.

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.*]

Double Innervation of Striated Muscle.

IN the *Proceedings of the Anatomical Society of Great Britain and Ireland*, just published in the *Journal of Anatomy*, there is a record (page 498) of a communication by Prof. H. H. Woollard on the innervation of voluntary muscle, which is of unusual importance from its bearing upon a question that is a matter of widespread controversy at the present moment. My purpose in directing attention to Dr. Woollard's observation, however, is not so much to emphasise its intrinsic significance as to suggest the possibility of an interpretation other than that adumbrated in his preliminary note.

For more than fifty years the problem has been discussed whether striated muscle has a double nerve supply (in addition, of course, to the sensory nerves connected with the muscle spindles). Interest in this question has been revived during recent years by the observations of Prof. Boeke, of Utrecht, who claims that each individual muscle fibre is provided with two nerves, a medullated somatic fibre and a non-medullated fibre, which he regards as being sympathetic in origin.

When, in 1879, Tcheriev directed attention to the fact that the two types of efferent fibres, which twenty years previously Lionel Beale and others had detected in motor nerves, proceeded to different kinds of terminals, the medullated (Beale's "dark-bordered fibres") to the end-plates of Kuehne, and the non-medullated (Beale's "fine pale fibres") to grape-like endings, little attention was paid to the observation. For the opinion was then current that the fine muscle-fibres—even perhaps the spindles—and their nerves were the embryonic forms of the larger muscle fibres and their medullated nerves (see Koelliker's Croonian Lecture in 1862).

In 1909 and the succeeding years Boeke revived interest in the matter once more. He dissented from the earlier observations by claiming that both kinds of nerves proceeded to the same muscle fibres. Then the matter began to attract widespread attention, which was largely due to the fact that the attempt was being made to interpret the phenomena of muscle tone in terms of the assumed sympathetic nature of the non-medullated nerves. After Prof. Boeke brought his preparations to London in 1921, my colleague J. P. Hill suggested to the late Prof. Kulchitsky, who had just come to work in this Department, the desirability of investigating once more the problem that had been the subject of his first original work thirty years earlier.

In 1924, Kulchitsky published the results of this new research on the innervation of the muscles in snakes, in which he demonstrated once more, as Tcheriev and many others had done previously, that the two types of nerves did not pass to the same muscle fibres. In other words, he was unable to discover any muscle fibre receiving both kinds of nerve fibres. Hence there emerged a sharp conflict between the results obtained by Boeke on the extrinsic muscles of the eye in mammals and by Kulchitsky on the subcutaneous muscle of the body in snakes.

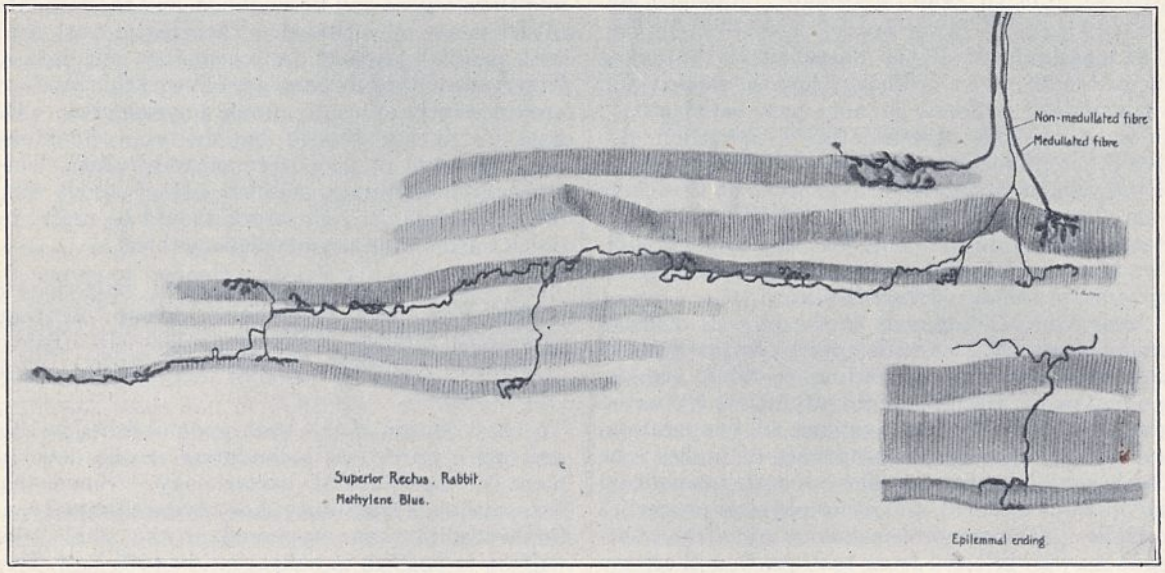

FIG. 1.—Dr. Woollard's preparation of a rabbit's muscle showing double innervation.

During the last three years the question of the innervation of striated muscle has become a matter of acute controversy. Doubt has been thrown upon the existence of non-medullated fibres in motor nerves, and in particular upon the claim that the non-medullated fibres were derived from the sympathetic; and alternatively the suggestion has been made that the type of innervation found by Kulchitsky in the snake might not be found in mammals.

Using the methylene blue method of staining, Dr. Woollard (after a very prolonged and laborious search) has been able to demonstrate (see Fig. 1) in the case of the superior rectus muscle of the rabbit, a double innervation conforming to that described by Kulchitsky in the case of the snake. The rabbit's eye-muscle, like that of the snake's body, consists of two kinds of fibres, coarse and fine. In both cases the coarse fibres are more than double the diameter of the fine fibres, and whereas the coarse fibres receive medullated nerves proceeding to typical end-plates, the finer muscle fibres receive only non-medullated nerves proceeding to grape-like endings, placed epilemmally upon the muscle fibres. Moreover, these endings are disposed in such a way (a number of them

being connected with a single nerve fibre widespread on several muscle fibres) as to make it impossible that they could develop into the ordinary end plates. Incidentally, the new observations of Kutchitsky and Woollard that the medullated fibres end hypolemmally and the non-medullated epilemmally, settle once for all the old dispute of sixty years ago (Kuehne, Koelliker, Beale, Margo, Rouget, Naunyn, and Engelmann) as to whether motor nerve fibres did or did not perforate the sarcolemma. As some do and others do not, each group of controversialists had some evidence to support their claims.

The importance of Dr. Woollard's demonstration lies in the fact that it removes once for all the doubt as to the existence of this type of double innervation in mammals. It also proves that the two types of muscle fibres (and associated nerve fibres) are morphologically distinct one from the other. In his communication, however, Dr. Woollard lays particular emphasis on the fact that he has found this type of double innervation only in the case of the eye-muscles and not in any other part of the body.

It is important, however, not to lose a sense of perspective in estimating the meaning of this observation. In 1882, Dr. L. Bremer, of the University of Strasbourg, described (*Archiv. f. mikr. Anatomie*, Bd. 21) non-medullated nerves ending in the muscles of the tongue and limbs in the frog (see in particular his figures 13 and 20) in precisely the same manner as Dr. Woollard has depicted in the case of the eye-muscles of the rabbit. The coincidence is most striking and significant.

In view of these facts, especially when taken in conjunction with the difficulty Dr. Woollard himself experienced in discovering such endings in the eye-muscles, the failure to obtain satisfactory proof of the presence of such nerve fibres in other mammalian muscles should not be assumed to imply their absence. When they are found so widespread in the muscles of the trunk, limbs, and tongue of amphibia and reptilia and in the ocular muscles of mammals, there is a presumption that one is dealing with a morphological fact that applies to all striated muscles. But it remains for future research to provide conclusive evidence for or against this morphological inference —a problem that Dr. Woollard proposes to investigate in the University of Adelaide.

G. ELLIOT SMITH.

University College,
London, W.C.1, July 20.

Banded Structure in Aluminium and Copper.

IT is a well-established fact that copper, gold and silver, in the native state, exhibit twinning on the octahedral plane.

I have recently examined, by means of X-rays, structures in aluminium which resemble lamellar twinning, and a sample of native copper which contained large well-marked lamellar twins. Such structures are always to be found in copper and its alloys, as well as gold and silver, if the metal has been worked and annealed, but are rarely found in cast metals. In aluminium they are rarely met with, although this metal has the same crystal lattice. The orientation in both parts of the 'twin' were determined. Two samples of aluminium were investigated, which showed the same relationship existing between them. These appeared to have one dodecahedral plane in common, but the one could only be derived from the other by turning one upside-down and rotating through an angle of 60°. The plane of junction between the crystals had no relation to the crystal structure of either. This was also the case in the copper sample. Here there appeared to be no important crystal plane or direction which was common to both parts.

It has always been assumed that the banded structure in these metals represented twinning on the octahedral planes of the crystal, but the examples quoted above show that this is not always so. It will, of course, be necessary to compare a number of samples of all the metals mentioned with the view of arriving at any definite conclusions.

C. F. ELAM.

Acarine Disease and the Muscles of the Honey Bee.

THREE years ago, Dr. Rennie suggested to me that as a part of the research on acarine disease of the honey bee, I should attempt to describe certain pathological appearances in the indirect muscles of the wings, since visible pathological conditions of these muscles are often, but not invariably, associated with acarine disease. The results of the investigation will be published in two parts shortly, and this letter contains the announcement of some of the main conclusions with a plea to biochemists to study these particular muscles of the bee in detail, since they seem to lead to an exceptionally clear path to the cause of contraction of muscle.

Before the pathological appearance of muscle could be accurately described, it was necessary to know the appearance of muscles which were deemed healthy since they were removed from lively bees which showed no signs of any of the known bee diseases. A thorough review of the literature showed that on the histology of the muscles there was no work sufficiently detailed or accurate to be accepted as a basis on which to describe pathological conditions. In fact, the muscles have been greatly neglected, and no description exists which includes, with the appearance of the contractile elements, an account of the nuclei, sarcosomes (reserve 'food' material placed between the contractile elements), innervation, tracheation, attachment to integument, and blood supply of any of the muscles of the bee. The literature on the muscles is very incomplete, scattered, and often inaccurate, and even the somatic musculature has been so neglected that many of the most important muscles are not recognised.

The first part of my paper attempts to deal with the name, function, innervation, tracheation, method of attachment and probable blood supply of every muscle or system of muscles in the three castes of *Apis mellifera* L. of different races, and it includes histological descriptions of fresh and variously prepared fibres as well as a brief description of their chemical composition and a note on their appearance under polarised light. The course of air through the tracheæ and the physiology of the nervous system in regard to the musculature is also considered. The second part of the paper deals with pathological conditions of the muscles.

Histologically the muscles of the adult bee can be classified as either *fibrous* or *tubular*. Fibrous muscle is characterised by its fibre being very easily split into 1000-2000 sarcostyles (fibrils) which are the apparent contractile elements of the muscle. The nuclei are scattered in many rows throughout the thickness of the fibre. Corresponding to the transverse striation of the fibre, there occur layers of semi-fluid substance (sarcosome substance) which seem to be utilised directly during the contraction of the fibre. Fibrous muscle is confined to the four large muscles attached to the walls of the thorax. These muscles are called the indirect muscles of the wings, since by altering the shape of the thorax they raise and lower the wings for

flight. Tubular muscle includes all the other muscles such as somatic, splanchnic, cardiac, dorsal diaphragm, ventral diaphragm, and muscles of the reproductive organs. Its fibre is usually a tube with a narrow lumen in which lies a single row of nuclei. The sarcostyles forming the wall of the tube are very firmly bound together and I have not detected sarcosomes between them. There is no unstriped muscle in the bee.

Two different pathological states of fibrous muscle may be associated with acarine disease in bees. They differ in appearance and have their origin in different physiological conditions. They may occur together or singly or be absent in a bee harbouring *Acarapis woodi* Rennie in its tracheæ.

The case in which some muscle fibres degenerate, becoming white, brittle, and unable to contract, is due chiefly if not entirely to the blocking of the first thoracic spiracle(s). The diseased condition of the muscles can be produced experimentally (cf. White, *Trans. Roy. Soc. Edinburgh*, **52**, 1921) by artificial blocking of the anterior spiracle(s). The obstruction of the spiracle(s) interferes with the forward direction of the respiratory current of air, and with the obstruction is associated an inhibition or complete arrest of active flight. Young bees seem able to resist the consequences of the loss of flight better than old bees. In the case of 'crawlers' whose tracheæ do not contain many mites, and in the case of active flying bees whose tracheæ contain numbers of mites, it seems to be a matter of how the mites lie in the tracheæ and of many other factors which have to be determined for each bee.

Once flight has stopped the bee ceases to defæcate, thereby setting up many troubles of metabolism in all parts of the body. The fibrous muscles are the seat of very active metabolic changes. A supply of oxygen is essential for long-continued muscular activity, and from the histology of fibrous muscle it seems legitimate to assume that most of the oxygen would be received from the tracheoles while the rest comes from the blood. The semi-fluid sarcosome substance consists apparently of albumin, glucose, the respiratory pigment, cytochrome, lecithin, and perhaps other lipins and probably various inorganic salts. It apparently acts as a reserve 'food' substance, passing in and out of the sarcostyles in a perfectly regular manner, depending on their state of contraction, and it is also very intimately united with the tracheoles. Presumably it is being constantly replenished by the blood and tracheoles in a healthy bee. Should the blood be loaded with toxins as the result of the non-defæcation of the bee, it seems probable that it would deposit some of its poison in the food-store for the muscle fibres, and this would be extra harmful if the fibres were already suffering from an impoverished oxygen supply from the tracheoles.

The waste products of metabolism resulting from muscular contraction can only pass away via the blood and tracheæ. During acarine disease the lumen of the tracheæ is liable to become obstructed, and if so a path for vital reactions is closed. When this happens the sarcosomes lose their orderly arrangement and become very much enlarged by coalescence with one another, probably because they are chemically very unstable and require the balance which is supplied only by the properly functioning tracheæ. Once the stability of the sarcosomes is affected, the contractile elements depending on them are thrown out of action, and so the muscle fibre suffers a change leading to death if the obstruction of the tracheæ is continued for long.

The other case, in which portions of muscle fibres assume a brown or black colour, seems the effect of oxidation of a substance in the blood, probably dioxyphenylalanine, which turns black in the presence of oxygen, an alkaline oxidase, and water. The dark pigmentary colour of the bee, and probably also the blackening of the tracheæ in acarine disease, are probably due to the same substance. The darkening of the muscle, *i.e.* deposition of pigment in a fibre, does not seem to affect the contractibility of the fibre or to interfere greatly with its normal metabolism. It is the normal reaction to direct injury of normal tissue bathed with blood, and it can be produced experimentally with ease. It assumes its deepest colour where apparently there is most oxygen, *i.e.* near a trachea. The same holds true when it is associated with acarine disease, when presumably it is the result of mechanical injury to the muscles by the mite. In acarine disease the darkening very rarely occurs alone. Almost always it is near a trachea in the centre of a fibre or part of a fibre which is degenerating and becoming whitish and brittle.

GUY D. MORISON.

Marischal College,
University of Aberdeen.

Discovery of Stone Implements of Lower Palæolithic Age in Ireland.

FOR many years past, as is well known, the prevailing opinion among archæologists has been that no traces of palæolithic man have come to light in Ireland; and it has been generally believed that he never lived in that country. During recent visits to Rosses Point, Sligo, I had considerable opportunities of examining the coast sections and the beach material

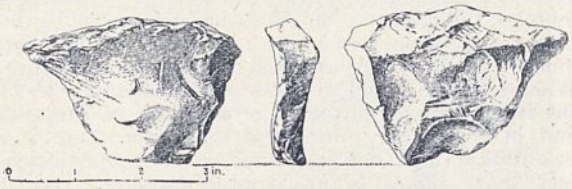

FIG. 1.—Three views of large racloir in limestone from Rosses Point, Sligo.

there exposed, and I have been so fortunate as to discover a series of implements, and flakes, in limestone which, by their *provenance* and forms, I do not hesitate to refer to the Lower Palæolithic (Early Mousterian) period.

On the western, or seaward, side of the middle limestone promontory at Rosses Point, which separates Drumcliff and Sligo Bays, there are to be seen the remains of a rock-shelter. The shelter has a south-

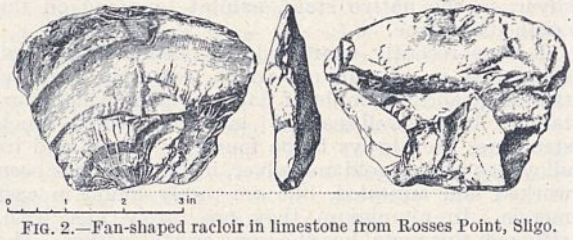

FIG. 2.—Fan-shaped racloir in limestone from Rosses Point, Sligo.

westerly aspect, and now occupies an area of about 47 feet by 9 feet. The floor is 5 feet above present high-water mark, whilst the roof is 8 feet above. These measurements are taken at the back of the shelter. Covering what is left of the roof is an Early Neolithic raised-beach consisting of powdered shells to a depth of 1 foot. The outer margin of this beach rests in a hollow in the Boulder Clay which formerly

covered a portion of the headland, but was partially eroded in Early Neolithic times. Under the large blocks of rock, evidently fallen from the roof of the shelter, I found more than 100 unrolled flakes and flake implements made of limestone. Some of these flakes are very large and weigh so much as 36 lb. The artefacts discovered may be classified as follows :

Levallois-like flakes.
Side racloirs (Fig. 1).
Fan-shaped racloirs (Fig. 2).
Choppers.
Ovate hand-axes.
Pointed hand-axes (Fig. 3).
Square-ended scrapers.

A little more than a mile to the south of the above-mentioned site, upon Coney Island, the remains of a large cave may be seen. It is now 50 feet wide, 4 feet high, and 6 feet from back to front. The

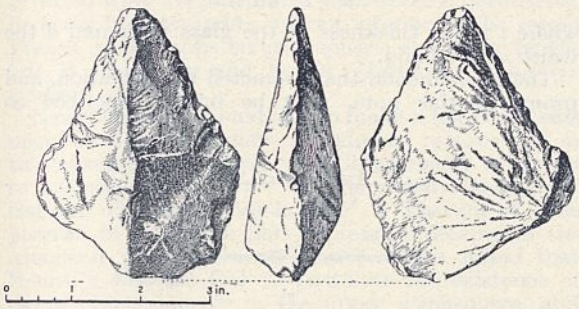

FIG. 3.—Massive hand-axe in limestone from Rosses Point, Sligo.

cave faces north-east and its floor is below the level of high tides, with the result that the contents have been drifted out and along the coast for a distance of half a mile, and are now found there upon the beach. These implements, two of which are remarkable examples of Lower Palæolithic workmanship, are, as would be expected, rolled, and exhibit on their surfaces marks due to collision with other stones.

In addition to an examination of the sites at Rosses Point and at Coney Island, I have carried out a close investigation of the sections of Boulder Clay visible upon the coast, and at Ballyconnell, situated

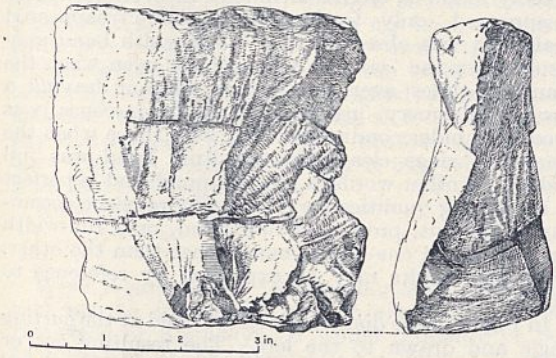

FIG. 4.—Prepared core in limestone found *in situ* in Boulder Clay at a depth of 39 ft. from the surface at Ballyconnell, Sligo.

5 miles to the north-west of Rosses Point, I discovered, *in situ*, at a depth of 39 feet from the surface of the ground and embedded in Boulder Clay, a core, with facetting upon both platforms, and a massive flake used as a hollow-scraper, formed of limestone. One of these specimens (Fig. 4) weighs 12 lb., and exhibits glacial striæ on both faces. The occurrence of the artefacts in Boulder Clay affords conclusive evidence of their antiquity, and, apart from any other circumstances, makes it in the highest degree probable that the other specimens of the same type from Rosses Point and Coney Island are older than the Boulder Clay represented at Ballyconnell. The section at this place shows the following strata :

Landwash, 4 feet.
Boulder Clay, 35 feet.
HORIZON OF FLAKE IMPLEMENTS.
Boulder Clay, 7 inches.
Middle Limestone.

From the researches I have carried out it seems clear that the specimens :

(*a*) are of undoubtedly human origin, and of Lower Palæolithic (Early Mousterian) types ;

(*b*) are older than a deposit of Boulder Clay present upon the Sligo coast ; and

(*c*) have a considerable distribution, and are not confined to one site only.

The surfaces of the artefacts exhibit a different colour from the freshly broken limestone, and some show patches of what appears to be a very definite patination. The material from which the specimens are made has a well-marked conchoidal fracture, and was very skilfully flaked by the palæolithic hunters of Sligo.

I hope in the near future to publish a full and illustrated account of my discovery.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2.

I HAVE examined a large series of the remarkable specimens collected by Mr. Burchell in Sligo, Ireland, and, at his request, I add a few lines to the preliminary note on his discovery. In the first place, I have no doubt that these specimens were flaked by man, and, secondly, that their forms are such as were made in Lower Palæolithic, Early Mousterian, times. Though I have not yet visited the sites where Mr. Burchell has worked in Ireland, and am thus not able to testify, from personal observation, as to the soundness of the geological evidence upon which he relies, yet I believe, after a study of his carefully recorded details of the *provenance* of the specimens he has found, and an examination of one of three artefacts discovered by him embedded, at a depth of 39 feet, in Boulder Clay at Ballyconnell, that this evidence is satisfactory. Many of the Sligo implements are of impressive size and appearance, and I hope it may be possible, in view of the manifest importance of Mr. Burchell's discovery, to publish accurate wash-drawings of these, of the natural size.

J. REID MOIR.

One House, Ipswich.

Evolution: Emergent and Resultant.

IN adhering to the position already outlined (NATURE, July 16, p. 81), I should like to suggest further that there is a fundamental distinction between what happens to be inferable "on the basis of existing knowledge," and what is not inferable under any intellectual conditions whatsoever. (In the present connexion 'inferable' is more relevant than 'deducible,' since not deduction alone, but all forms of inference, are legitimate.) What was not inferable by their predecessors, for example, was inferred by Newton and Darwin themselves. But it is often argued that the existence and qualities of certain "integral wholes" can never be inferred and explained from "the most complete knowledge"—not merely "existing knowledge"—about their constituents possessed by any finite mind whatever. (I exclude infinite mind in order to limit the discussion.)

This position appears to me to be quite unjustified

by the essential tendencies of modern research. As soon as knowledge ceases to be merely elementary (and with all its limitations, this at least is true of modern knowledge), its realised content yields plain indications of the nature, scope, and potentiality of knowledge *as* knowledge. We begin to understand both what knowledge is capable of doing and also why it possesses this capacity, even while we realise the drastic limits of its immediate advance; nor can it be objected that this issue is not strictly scientific, since epistemology stands on precisely the same footing as physics: how minds know, in other words, is fully as scientific a problem as how bodies move. We are concerned, therefore, not only with the *established content* of knowledge, but also, and to a still more important degree, with the *intrinsic nature* of knowledge.

From this point of view, Prof. Lloyd Morgan's criterion seems to afford a merely relative distinction between emergents and resultants; since, as knowledge expands, the first must obviously fall within the second. We require, therefore, as he suggests, some method of regarding certain "integral wholes" as being at the same moment (*a*) inferable in principle and (*b*) unprecedented in character, and so undeniably emergent. I venture to suggest that this situation resolves itself into the evolution of existentially new syntheses whose nature, and the nature of whose elements, are fully knowable (in principle) by finite minds, which can also infer that such syntheses will necessarily and causally precede processes hitherto non-existent. Television exemplifies this situation on a relatively simple scale, and the immortal drama of the future on a much more complex scale; and in this connexion two further essential features must be considered. The first is the degree of *complexity* presented by the structure of the synthesis; the second, which is obviously closely associated with the first, is the degree of *contrast* with earlier syntheses. When the contrast is slight, as in the summations mentioned by Prof. Lloyd Morgan, emergence scarcely arises at all.

Thus both television and the future drama are emergent, because both, taken in their entirety, are unprecedented, despite their widely differing forms. At the same time, each is the final culmination of antecedent tendencies, which are never (in principle) indiscernible as data for inference; whether they can be so employed or not depends on the intellectual capacity of the investigator. In principle, therefore, every "integral whole" and all its effects are inferable and, consequently, also resultant. But if, like finite mind at its first origin, any had never pre-existed, it would equally be emergent; while if, like the earth's future revolutions, any had pre-existed, then it would be not emergent but resultant only. Emergence thus becomes an additional characteristic, or quality of a higher order, the differentia of which is marked, or even absolute, existential novelty. Every emergent arises like Aphrodite from the foam, unparalleled—once again the element of contrast—but not therefore inexplicable and non-inferable. If, then (as a final concrete example), the biochemical synthesis of living organisms is effected within the next few decades (as is by no means impossible), these should, in my opinion, be regarded as emergent for two reasons: (*a*) because they would share the emergent quality of life as such; (*b*) because, as artificial, they would be unprecedented; while (*c*) they would also be completely explicable and inferable from man's actual precedent knowledge.

J. E. TURNER.

University of Liverpool,
July 23.

Diamond-glass Fluorescence.

THAT fluorescence may result when a glazier's diamond is drawn over the surface of a pane of glass was shown by Foley many years ago (*Science*, N.S., vol. 13, No. 332, May 10, 1901). This phenomenon may be studied indirectly in two ways: (*a*) by ruling with a diamond on the back of a photographic plate, (*b*) by placing a clear glass plate on the film side and ruling on that. In either case on development a distinct darkened band will appear (if there was fluorescence) the width of which depends on the thickness of the glass plate that was ruled and the angle of total reflection. In (*a*) the affected portion of the film is of course on the under side next to the glass, and the development consequently is considerably slower than in (*b*), where the exposure is on the front side of the film. The angle of total reflection in either case is given by the relation

$$d = 2t \tan \theta,$$

where t is the thickness of the glass plate and d the width of the band.

The phenomenon that attracted my attention, and prompted this note, may be briefly described as

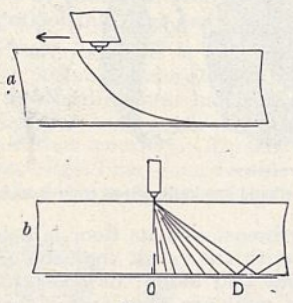

FIG. 1.

follows. Recently, while cutting photographic plates into strips for a special purpose, it was noticed that the bands for the particular diamond used were oftentimes only half the width of those described by Foley; also that if the bands did appear on both sides they were generally of unequal density; and, moreover, one or the other of the bands were occasionally found to be discontinuous, or even both sides disappeared, only farther on to have reappeared again. It was observed that a full-width band may result when the 'cut' is a scratch, or even when the diamond glides over the surface without leaving a trace. In every instance when fluorescence was produced under conditions other than those when the diamond 'rings clear,' the resulting band was full width. In other words, a new diamond that is perfect in its cutting qualities may, when fluorescence accompanies the cut, produce a half band, or a full-width band in which one-half is more dense than the other. Why this results may be explained by reference to Fig. 1.

In Fig. 1, *a*, the diamond is shown held at the cutting angle and drawn to the left. The resulting cut or crevasse opens in *advance* of the cutting edge, and ultimately may open up entirely through the plate, as shown. This crevasse forms a totally reflecting surface confining the light emanating from the point of contact (which is at the side of the diamond and not at its tip) wholly on one side, as shown in Fig. 1, *b*. The band begins abruptly at *O*, increasing in density to the right, and ends abruptly when the critical angle is reached at *D*.

If the other side of the diamond produces fluorescence also, then the total width of the band is 2*OD*.

However, this half, as stated before, may differ widely in density from the first. If the diamond is a poor one and scratches or merely rubs the glass surface, the resulting band, if present at all, is always of width $2OD$.

Others may also have observed the one-sidedness of this phenomenon when using a new glazier's diamond. CHAS. T. KNIPP.

Cavendish Laboratory,
Cambridge, July 20.

Atmospheric Electricity.

IN NATURE of Mar. 5 (Suppt., p. 6), Dr. Chree gave an excellent review of my book "Die elektrische Leitfähigkeit der Atmosphäre und ihre Ursachen" (Vieweg und Sohn, Braunschweig, 1926), which will appear in English within this year. I am much pleased to see that Dr. Chree, who is an authority of world-wide reputation in atmospheric electricity, finds my book valuable and not inferior to the recent French monographs on atmospheric electricity by the late B. Chauveau and by Dr. Mathias and his co-workers.

Nevertheless, I should like to make a few comments upon Dr. Chree's review in order to remove one or two misunderstandings. Dr. Chree seems to object to my use of the term "Kennelly-Heaviside-layer" instead of "Heaviside-layer." I thought I was justified in using the first expression because in the American journal *Science* (1925) it was stated that Kennelly was the first to postulate the existence of the conductive layer in the upper atmosphere, and not Heaviside. If in this I am wrong, I will gladly alter this in the English edition of my book.

At the end of his review Dr. Chree says: "Dr. Hess does not, however, seem to notice that if the somewhat serious defect in the Ebert apparatus, which he accepts as proved by Prof. Swann, really exists, then much of the information which appears in the present book and elsewhere respecting negative ions must require correction." To this I must add that in choosing the numerical data on ionic numbers for my book I tried to select only those taken in places where the apparatus was well screened from the electric field of the atmosphere. Observations taken under these conditions are fortunately more numerous than those unscreened in the open air, and therefore I believe that the data given in my book require no correction whatever. From my own experience I should think that the effect of the earth's field disclosed by Swann was overestimated in some cases, and that the distribution of ions, as found in electrically well-screened places (under the leaves of trees, in open windows, verandahs, etc.), is not very different from that in the open air. V. F. HESS.

University of Graz,
Austria.

WITH regard to the 'conducting layer,' my objection was to associating it with the name of *either* Heaviside or Kennelly. It would probably be best, as in the case of the 'penetrating radiation,' to attach no personal name, but if a name is to be attached, the claims of Balfour Stewart, as I have already explained in the columns of NATURE, seem to me to come first.

With regard to results from the Ebert apparatus, I noticed no explicit statement in the text that only those stations had been included where the apparatus was specially sheltered, and in at least one or two of the cases mentioned I had reason to believe that the contrary was the case. I am personally inclined to share the doubt now expressed by Prof. Hess whether Prof. Swann's unfavourable conclusions are in actual practice fully justified. Some experiments, in fact, made at Kew Observatory by Mr. E. H. Nichols ("Terrestrial Magnetism and Atmospheric Electricity," 1916, p. 87) did not confirm Prof. Swann's conclusions. But there seems no reference to these in Prof. Hess's book, and I had supposed him to accept Prof. Swann's conclusions without reserve. My own view is that an independent investigation into the conditions under which the use of the Ebert apparatus is wholly satisfactory would be useful. I am glad to hear that we may expect an English version of Prof. Hess's valuable book. C. CHREE.

The Depth to which Whales Descend.

WHEN a whale is attacked, it usually attempts to escape by 'sounding' or going vertically down; the rope it takes out on these occasions is a good measure of the depth it descends to, and the attacking boat, owing to the strain on the line, an indicator of its position under water.

The Right-whales appear to descend to greater depths than the Fin-whales, and on this account to be more easily captured. When the Greenland whale is attacked, it usually leaves the surface and descends immediately; it takes out rope very quickly and soon reaches a great depth. After a time it reappears near where it went down in an exhausted condition and is easily captured. Large ones appear to descend to a depth of 700-800 fathoms and remain under water nearly an hour. Sometimes the Greenland whale dies at a depth of 800 fathoms, and sometimes, as related by Scoresby, if the depth of the water is not sufficiently great, it strikes the bottom while descending and kills itself in this way; in both cases it has to be hauled up dead.

It is only when it is attacked in very deep water with the hand or simple gun harpoon, as in former days, that the Greenland whale descends to a great depth and that the boats engaging in its capture require to carry a very long line; in water of moderate depth a much shorter one suffices. This fact is surely in itself a sufficient answer to those who, on purely theoretical grounds, deny that whales can descend to great depths.

The blubber of whales appears to be related in some way to the depths to which they descend. In the Greenland whale, for example, it is very much thicker than in its congener the narwhal; perhaps its great thickness enables it to withstand the pressure at great depths? R. W. GRAY.

Ophion luteus.

THE shrill sound of this fly is here a sure nocturnal herald of the Dog Days. Nearly six years ago I described in NATURE (Nov. 10 and Dec. 1, 1921) how some members of my household had been stung by the fly; but it was not until last night that I was favoured by its attention. The weather being very sultry, I was sleeping under a single sheet when I was awakened by a sharp stab in my thigh. Clapping a hand on the place, I missed the intruder; but immediately after was stung on the left arm and this time caught *Ophion luteus*.

The incident would not be worth recording were it not that it puzzles one to understand what can be the motive in this fly, when not molested, in thrusting its ovipositor into a human being. It would be interesting to hear whether other persons have received similar attention from this or any other species of Ichneumonidæ. HERBERT MAXWELL.

Monreith, Whauphill,
Wigtownshire, Aug. 7.

Some Colouring Agents in Glasses and Glazes.[1]

By Sir HERBERT JACKSON, K.B.E., F.R.S.,
Director of Research, British Scientific Instrument Research Association.

THE colouring agents of glasses and glazes are very many; moreover, several of these agents can impart colour to glasses or glazes in what may be described as different ways. An explanation which would include all our present knowledge of the behaviour of any one of them would occupy a long time. I have chosen two colouring materials, copper and iron, and propose to deal with some of the effects which can be produced by them and their compounds. I should like also to make a few remarks on certain effects which can be produced by radiations such as ultra-violet light, X-rays, and gamma-rays from radio-active materials.

I have chosen copper and iron because, in their various modes of action as colouring agents in glasses and glazes, they illustrate fairly completely the manner in which most of the materials used in this connexion behave. For present purposes I will not draw any definite distinction between glasses and glazes, but will use the terms somewhat indiscriminately.

Copper can be introduced into a glass or glaze so as to produce reds, browns, yellows, greens, blues, purples, and black. In some instances the colours can be well seen by transmitted light; in others the material is too opaque to show the colour except by reflected light. These various effects are produced by compounds of copper or by metallic copper itself. Of the compounds of copper, attention will be especially devoted to the two oxides of copper, cuprous oxide and cupric oxide. Cuprous oxide is the colouring agent in the brilliant scarlet Egyptian glass, specimens of which appear to be correctly attributed to at least as far back as the XVIII. Dynasty and up to Roman Egyptian times. It would appear from the absence of any specimens attributable to more recent times that the knowledge of how to produce this glass successfully was then lost.

Microscopic examination of a specimen of the scarlet Egyptian glass given to me some years ago by Prof. J. N. Collie, and of other specimens given to me more recently by Mr. Horace Beck, showed that the colour was due to small crystals of cuprous oxide. Chemical examination of the glass itself revealed that it was an ordinary lead glass containing about 30 per cent. of lead oxide, and the quantity of cuprous oxide varied from about 8 per cent. to 10 per cent. Based on this information the glass was successfully made after a few trials. During those trials yellow crystals were often observed in parts of the glass, and recently Mr. Horace Beck provided me with an orange yellow bead found at Faversham, in Kent, the colouring matter of which was again identified as cuprous oxide, but mainly in the yellow form. The red form of cuprous oxide is the better-known form, and is produced when copper is heated in a limited supply of air; it can generally be well seen on the underside of the black scale detached from a piece of metallic copper which has been heated for a short time to a high temperature in air and then kept at a lower temperature for some time.

A ready method of producing the red oxide is to add a solution of copper sulphate to a solution of glucose and then to add caustic potash to the mixture. On heating the clear blue solution so obtained, reduction of cupric oxide by glucose occurs, with consequent precipitation of red cuprous oxide. At the first stage of heating it is generally possible to notice the formation of a yellow precipitate mingled with the red; these colours can be better shown by using Fehling's solution, which is made up from copper sulphate, Rochelle salt, and caustic potash, and is a clear blue solution. If a small quantity of the solution of glucose be poured into a large quantity of boiling Fehling solution the red oxide is formed. If a small quantity of Fehling solution be added to a large volume of boiling solution of glucose, the yellow form is produced, and is permanent in the sense that it may become rather more orange in tint but does not reach the red stage.

Without going into the doubtful composition of this yellow form, in respect of the extent to which it may be considered hydrated, it may be remarked that if it is heated out of contact with air the yellow form persists, and is apparently completely freed from water at a temperature of about 350° C. The difficulty of making any statement about the temperature at which the yellow form can exist in glass will be appreciated if a short description is given of the behaviour of cuprous oxide glass during its preparation.

If the proportion of cuprous oxide introduced into the glass be about 8 per cent., the whole of it dissolves in the glass at the temperature of 1000° C. at which the glass is made. If the glass be quickly chilled from this temperature, no colour, except the almost unavoidable green colour due to oxidation of part of the copper, will be seen; the glass is a nearly colourless transparent one. On re-heating this glass it is possible to produce, according to the temperature to which the glass is raised and the length of time during which it is heated, comparatively large crystals or aggregations of crystals of red cuprous oxide, smaller crystals of the same form, or particles so small as not to be recognised as crystals under the microscope. Along with these are frequently obtained definite crystals of the yellow form, clouds of yellow particles, and, if the re-heating be gentle, the particles of yellow cuprous oxide are so small as to be unrevealable by the microscope, and what is obtained is a clear yellow transparent glass. Here, then, from two forms of one and the same oxide of copper, we have a range of colours associated with the proportions in which

[1] Discourse delivered before the Royal Institution on Friday, Mar. 4.

the two forms are mixed in the glass and with the size of their particles. What is the inner nature of the difference between the red and yellow forms which may account for their difference in colour is yet to be made out.

Much ancient Egyptian glass does not contain lead, but is mainly of the composition of an ordinary window glass—that is to say, its principal ingredients are silica, lime, soda, with varying quantities of potash, magnesia, and alumina. It has not been found possible to make the brilliant scarlet cuprous oxide glass satisfactorily in a glass of this composition. The temperature required for the proper making of such a glass is too high for the persistence of the scarlet colour, and the resulting glass is of a brown or brownish-red colour. A scarlet coloured glass of the common soda-lime type could be made if the composition of the glass were so chosen that its fusing point was as low as that of the lead glass which the Egyptians used. If the Egyptians ever did make such a glass, it would have been so unstable that it could scarcely be supposed any specimens of it would have persisted to the present day.

Ancient brown glass of the soda-lime type just referred to appears to have been very widely distributed. Recently I have been given some beads of this glass which, I am informed, work up through the sand on the coast of Zanzibar. Whatever attribution is given to the various specimens, they all seem to be very similar in composition and to depend for their colour upon the presence in the glass of minute particles of metallic copper. Whether the production of this brown or brownish-red glass preceded that of the scarlet glass is a question which cannot be dealt with here. It is worth while, however, to refer to one property of cuprous oxide. This oxide does not form salts with acids except with the halogen acids: hydrofluoric, hydrochloric, hydrobromic, and hydriodic. With the oxygen-containing acids, if it re-acts with them, metallic copper is produced along with a cupric salt of the acid. With sulphuric acid this change takes place at the ordinary temperature; with a weaker acid, like acetic acid, the action is very slow unless the temperature is raised.

Taking these reactions as analogous to what may occur in a glass, and considering silica as a weak acid, it will be understood that if the temperature of a glass, either the lead glass or the soda-lime glass, be raised high enough, the result will be the production of metallic copper dispersed through a greenish cupric oxide glass. If the percentage of cuprous oxide used were high, about that used for the scarlet glass, there would be sufficient green to make the red of copper look, by reflected light, distinctly brown. With less copper present the colour would get nearer to a red, and it will be easily understood how, by using progressively less and less copper it would be possible to arrive at a glass resembling the well-known red glass which owes its colour to particles of copper so finely comminuted as to render the glass quite transparent to the eye. The transparent red copper glass and the brilliant *sang-de-bœuf* Chinese glazes are made under conditions which tend to reduce any cupric oxide which may be formed, so that the resulting glass is not rendered dingy by a green tint, due to dissolved cupric oxide, marring the brilliant red due to the dispersed metallic copper. It should be added that for this brilliant glass so little copper is used (it is in the neighbourhood of 0·5 per cent.) that any colour from cupric oxide which would arise from such a change as is mentioned above under the action of silica would be so pale as to have practically no effect on the brilliance of the red due to the dispersed copper.

Here, then, we have again considerable variations in the appearance of the glass dependent upon the size of the particles of the colouring agent dispersed through it, and this is made evident when thin pieces from different portions of glaze from one and the same Chinese *sang-de-bœuf* vase are examined by transmitted light. Under the microscope, for example, some pieces are distinctly red, others are purple, others again are blue, and others look like neutral coloured glass. Closer study shows that in the most brilliant red portions no particles can be seen by the microscope. In some of the less transparent red pieces, particles are revealed either by a cloudiness or as discrete particles. In the purples these particles are larger, and in the blues they are still more marked, while in the neutral colours the particles are generally seen less closely packed but distinctly larger in size.

The colours produced by cupric oxide in glasses and glazes need not be dealt with in detail, as there is much common knowledge about these. One or two points not in common knowledge may, however, be emphasised. In a glass of the same composition, cupric oxide may give a very marked blue colour if the glass is made at a comparatively low temperature (1000° C. to 1100° C.); whereas with the same concentration of copper and the same glass made at a higher temperature, about 1300° C., for example, there is a very marked green shade in the blue. It is worth pointing out that the blue low-temperature glass is green while hot.

It would lead us into too much detail to do more than direct attention to the possible analogies between the action of water in solutions of cupric salts and the action of the oxides of the alkali metals in glasses coloured by cupric oxide. The change from blue to green just mentioned in the case of the low-temperature cupric oxide glass calls to mind the fact that a green solution of cupric chloride, which becomes blue when sufficient water has been added, becomes green again on heating it. A study of the changes of colour which can be produced in aqueous solutions and salts, and of the methods of modifying these colours, has been of great assistance to me in shortening the experimental work necessary to arrive at the compositions of a number of glasses in which it was desired to produce certain colours either with copper or other colouring agents.

As an example of the change of colour effected by adding water to a salt, copper sulphate may be mentioned. This salt, in its anhydrous condition

or with only one molecule of water, is colourless. Crystals containing five molecules of water are the ordinary blue copper sulphate crystals, and the solution of these in water is blue. If we take boric anhydride and an oxide of an alkali metal as analogous to sulphuric acid and water, a very similar story can be told. A small quantity of cupric oxide does not dissolve in fused boric anhydride, but forms a white borate which is dispersed through the fused mass. The addition of an alkali will bring about solution and give a clear blue transparent glassy mass. The most striking example is to take boric anhydride and the alkali lithium oxide in, say, three different proportions, such as one molecule of lithium oxide to one, four, and ten of boric anhydride. With 0·5 per cent. of cupric oxide the first is a fine deep blue; the second is a paler blue; the third is still paler; and if the proportion of alkali oxide be lowered until there is only just sufficient to bring about complete solution of the cupric oxide in the mass, there is but little colour to be seen at all.

With many glasses made at a high temperature, cupric oxide gives an olive-green colour. Without going so far as to say that the dusky shade in the green is invariably due to some reduction of the cupric oxide to the lower oxide of copper, there is evidence of this in certain instances which I have come across. To take one: in making trials for a glass which was intended to be of a green colour with only a slight tinge of olive in it, and of a sufficiently light shade to enable the light of a candle flame to be seen through a 1-inch thickness of the glass, the furnace conditions happened to change on one occasion so that the glass was exposed to a reducing atmosphere. The resulting glass was so black that a bright June sun was invisible through a piece of the glass one-fortieth of an inch thick. Such a state of affairs might be considered to come about by the glass being a mixture of red copper glass with a green cupric oxide glass, through which mixture but little light could be transmitted. Now red glass owing its colour to finely dispersed metallic copper is rendered colourless by fusing it and quickly chilling it. The black glass referred to might therefore be expected to become green if fused and quickly chilled, but it did not change from its intense black colour. This just gives a hint of the possibility of a cuproso-cupric compound being present in the glass analogous to, though not so definite as, ferroso-ferric oxide, the well-known black iron scale.

Again, an analogy with solutions helps a little. If to a colourless solution of cuprous chloride in hydrochloric acid there be added a transparent green solution of cupric chloride, the mixture turns black. Although dusky greens and the black glass just referred to might be accounted for by varying mixtures of red and green glass, the colour of this solution could scarcely be accounted for in the same way. Moreover, in experimenting with red copper glasses, and studying the way in which the red colour can be prevented from developing by sudden chilling and can be produced by subsequent heating, I have repeatedly noticed that, instead of obtaining a clear colourless glass in bulbs made from the red glass and quickly chilled, the bulb has been sometimes of a dusky hue and sometimes of a definite neutral tint. As no other colouring agent but copper was present in these glasses, I am inclined to attribute the neutral shade to a cuproso-cupric compound which is stable in the glass and is analogous to the compound formed when the cuprous and cupric chloride solutions are mixed, rather than to a physical mixture of red and green glasses.

I must not deal further with cupric oxide glasses except to mention that, unlike cuprous oxide glasses, copper glasses and many other coloured glasses, such as gold glasses, selenium glasses, cadmium sulphide glasses, and opal glasses, cupric oxide glasses cannot be rendered colourless by sudden chilling, nor, indeed, can the tint of these glasses be modified to any noticeable extent in this way. An attempt to explain this difference, which seems to divide colouring agents generally into two classes, would involve a very lengthy account of the various phenomena which have been observed, and would, moreover, be to a considerable extent little more than a re-statement of facts which would involve differentiation between the meanings of such terms as 'solution,' 'chemical combination,' and 'dispersion,' and would lead to much argument. I must content myself with this short and incomplete account of the modes of behaviour of copper and its oxides in glasses and glazes.

Passing on now to iron, there are colours produced by ferric oxide, ferroso-ferric oxide and ferrous oxide, but I do not know of any glass or any material which could be called glassy which owes its colour to metallic iron in a fine state of dispersion. Starting in the first place with ferrous oxide, which gives the well-known green colour to glass of the nature of window glass, I need only point out that this colour is considerably modified by the composition of the glass, and without going into a number of details I will mention the way in which this tint is modified by the presence in the glass of zinc oxide or magnesium oxide. The former intensifies the colour produced by any given amount of ferrous oxide and changes the usual green into almost a blue. A similar change occurs with magnesium oxide, but the intensification of the colour is less marked. Among the alkalis, lithium oxide also tends to give a bluish tint to glasses containing ferrous iron. A notable example of this is seen in an early Chinese glaze which, through the kindness of Mr. G. Eumorfopoulos, I had the opportunity of examining. The thinner parts of this glaze are practically colourless, but the thicker parts have a beautiful blue tint. An examination of the glaze showed that it was for such glazes unusually rich both in lithium oxide and in magnesium, and the colouring material was identified as iron. If the Chinese workers had substituted zinc oxide for the magnesium oxide in their glaze mixture, the colour would have been very much more marked.

(*To be continued.*)

The Control of Insect Pests by Means of Parasites.

By Dr. S. A. NEAVE.

IN recent years agriculture in its broadest sense has received a powerful stimulus throughout the British Empire owing to the tremendous growth of the demand for vegetable and animal products of all sorts, especially in the more densely populated countries. In consequence, more and more attention has been directed to the insect and other pests of crops and domestic animals, and some recognition of the vast damage they do is becoming general. One result of this is that entomology, as an applied science, has attained a status and importance that would not have been thought possible a generation ago.

The almost world-wide attention that has been directed of recent years to problems of insect pests has naturally led to the investigation of new methods of controlling them. Though considerable strides on the chemical and physical side have been made in advancing our knowledge of insecticides and of apparatus for using them (even aeroplanes having been adapted for this purpose), it is now fairly widely recognised that such methods are seldom more than palliatives and necessarily involve an annually recurrent expenditure. Indeed, it is not too much to say that the damage done by insects, when the cost of keeping down their numbers is added to it, materially increases the cost to the consumer of nearly everything he eats and much of vegetable and animal origin that he wears or uses in other ways. Artificial control measures have the further disadvantage that most of them are unsuitable for use by the uneducated native populations, who are yearly producing more and more of the crops of cotton and other tropical products that are exported to other countries.

One of the primary causes of an insect becoming sufficiently numerous to reach the status of a pest is the action of man himself, who, in the processes of agriculture, destroys the equilibrium that exists under natural conditions between insects and their various enemies. A pest with a somewhat different origin, and one often most difficult to deal with, is an insect that has been accidentally or thoughtlessly introduced into a new country where the climatic conditions may be specially favourable to it and the natural enemies that kept down its numbers in its native country do not exist. That this should have already occurred in the temperate regions of the New World and of the southern hemisphere is not surprising, and some of the worst pests in Canada, South Africa, Australia, and New Zealand are in fact of European origin and not indigenous in those countries. Many examples of this might be cited, but one with which most people are probably familiar is that of the Codling Moth, which infests apples. This insect, though not of any great importance in England, and seldom found in numbers except in neglected orchards, is a major pest in all the more temperate parts of the British Empire. Elaborate spraying operations have to be carried out against it, and these materially enhance the cost of imported apples, while the fact that the best insecticide used for it contains arsenic has caused much loss and confusion to the trade in imported apples owing to the risk of arsenical residues being found on them.

Though every country now has a more or less elaborate code of quarantine laws directed to keeping out insect pests, they can never be an absolute safeguard, and it is too much to expect that what has happened in temperate climates will not repeat itself in tropical ones with the ever-increasing exchange of tropical products that is now going on. Indeed, the history of recent years shows that this is already happening, as can be seen by the spread, within the last ten years, of the dreaded Pink Bollworm of cotton into the New World.

Realisation of all this has led the modern entomologist to try to take a leaf out of the book of Nature, and to see whether what may be called artificial methods of insect control cannot at least be supplemented, and perhaps in some cases superseded, by utilising parasitic insects or other enemies to reduce the numbers of a given pest. Though this method obviously has great limitations and must be applied with great circumspection, it has the outstanding advantage that, if successful, its results are permanent, and that the expense it involves is limited to the original cost of the preliminary investigation and of the breeding, exportation, and establishment in its new home of the parasite concerned. It is not, however, suggested that this method can be expected to eliminate altogether the necessity for artificial control measures except in rare cases, since a parasite in the nature of things does not normally exterminate its host (a procedure that would involve its own extinction), but merely reduces its numbers to such an extent that a major pest may become one of minor importance.

It is obvious that great care must be exercised in the carrying out of such a scheme, and certain cardinal principles are involved. Perhaps the chief of these is that in the majority of cases the parasite selected for introduction must be a highly specialised one that is unlikely to affect the balance of Nature in its new home by attacking anything but its intended host or a species nearly allied to it. It is also important to discover the most effective parasite of the many that commonly attack a given host. Harm may be done by the importation of several parasites, all of which compete for existence in the same host. Though there is some doubt on the point, it has been stated that in Hawaii, where some of the pioneer work of this character has been carried on, when several parasites of the Mediterranean fruit-fly were simultaneously introduced into those islands, they ultimately proved less effective owing to the numbers of the most efficient species being reduced by competition with the others. Similarly, the utmost care has to be taken to eliminate all hyper-parasites, that is to

say, parasites of the parasite itself, for these may practically cancel its effect on the host, and it must be borne in mind that once such minute insects are established in a new country their eradication is impossible. Moreover, a parasite that is only moderately effective in its native country may become vastly more so in a new one if its hyper-parasites are absent. It will therefore be obvious that the successful accomplishment of a scheme of this character involves much careful and often lengthy investigations sometimes extending over several years, and that satisfactory results cannot be guaranteed in advance.

The Government of the United States has devoted large sums in recent years to establishing laboratories where work of this kind may be carried out, and early in the present year it passed an Act that appropriated no less than 10,000,000 dollars for work on the European Corn-borer, an introduced moth that is doing a vast amount of damage to maize, and the parasites of which are being bred in France for export to North America.

In order that a start may be made on these lines in the British Empire, the Empire Marketing Board has recently provided the Imperial Bureau of Entomology with funds to maintain a laboratory at Farnham Royal. Work has just begun there, but it is not to be expected that any important results can be attained before next year at the earliest, though it is probable that, as a small beginning, a Braconid parasite of the blow-flies that cause serious losses amongst sheep may be sent in the autumn to Australia, New Zealand, and the Falkland Islands. Several investigations have, however, been begun or are being planned, which, it is hoped, will benefit many other parts of the Empire, including Canada, Australia, New Zealand, South Africa, and Kenya Colony.

News and Views.

AN agreement between the I.G. Farbenindustrie (the German Dye Trust) and the Standard Oil Company of New Jersey for the exploitation of a new process for the production of synthetic petrol which the I.G. has evolved, was reported in the *Times* of Aug. 11. This agreement relates solely to the American markets, and further negotiations, it was stated, may be expected with European countries in respect of the realisation of the patent rights concerned. Much speculation appears to have arisen as to the precise nature of the process in question, as only the most meagre information has been officially forthcoming. But the few details provided in the *Times* report are sufficient to identify it with reasonable certainty as that which forms the basis of a group of very recent patent applications emanating from the I.G. This new process, described as the destructive hydrogenation of carbonaceous materials, appears to comprise nothing more than a development of the well-known Bergius method, according to which coal or similar material is subjected to thermal decomposition in the presence of hydrogen under pressure to produce hydrocarbon mixtures of the nature of petroleum. But whereas berginisation is essentially non-catalytic, the new process is based upon the discovery that the introduction of certain catalysts leads to the formation of more valuable hydrocarbons, with increased yields and at an enhanced rate.

THE first of these catalysts to be protected by the I.G. were compounds of nitrogen, whether added as such or formed *in situ* from added nitrogen; then followed molybdenum and its compounds, then chemically combined sulphur, then tungsten and chromium, until now a whole host of such substances have been described. Furthermore, the hydrogen need not be so highly concentrated as in the berginisation method; it may even be present as combined hydrogen, *e.g.* as hydrogen sulphide or methane, or it may be produced by the introduction of steam which reacts with the carbonaceous material. Otherwise, the reaction conditions appear to be very similar to those obtaining in the berginisation method. Like the latter, it is applicable not only to coal and other solid materials, but also to the treatment of tars, mineral oils, or their distillates, and even to such bodies as asphalts and resins. Presumably it is in the treatment of heavy oil distillates and residues that the Standard Oil Company is interested, for any process using coal as starting material could scarcely be an economic proposition for some years to come in the United States, considering its natural oil resources. It may be remarked that the engineering difficulties associated with the treatment of large quantities of materials under the high temperatures and pressures proposed (of the order of 500° C. and 200 atmospheres) are very considerable, even to an organisation like the I.G., which has unparalleled experience of the technique of high-pressure working. Any estimation of the commercial importance of the process must therefore be reserved until it has definitely emerged from the experimental stage and more detailed information is available concerning it.

IT is now twenty-one years ago since the Victoria Falls and Transvaal Power Company was granted rights to utilise the Falls for the generation of electric power. Hitherto the Company has only used steam plant to produce power, and recently it has received a communication from the Northern Rhodesia Government in which stress is laid on the principle that it is not in the public interest that this source of power should remain indefinitely unused. The Company has replied that it has always been anxious to utilise the power of the Falls commercially as soon as possible. It is quite willing that the rights and conditions granted twenty-one years ago should be suitably modified or expanded, in a similar way to that adopted in other countries for the control of power undertakings. The Company was founded with the object of supplying the Transvaal gold

mines with power from the Falls. It was soon found out that owing to the heavy costs of transmission the scheme was then commercially impracticable. The company has endeavoured to find an outlet for power in Rhodesia. The vast size of the country, however, the widely scattered white population, and the fact that the Falls are situated at such a great distance from centres where there might be possibilities of export trade, present serious difficulties in the way of development. It is doubtless these difficulties that have prevented industries requiring large amounts of cheap electrical power from being attracted to the country.

IN an interesting paper to the *Wireless World* of July 13, Captain Eckersley, the engineer to the British Broadcasting Corporation, discusses the considerations which led to the proposal to establish a new distribution of broadcasting stations in Great Britain so as to enable listeners to have the choice of alternative programmes. The problem is a difficult one owing to the variations in the reception depending on the distance from the broadcasting station. If an alternative programme is provided, it must be possible for any one to switch from one to the other with great ease. It is useless to give as an alternative a programme the reception of which is distinctly inferior. The author divides the service areas round a broadcasting station into zones, which he calls the 'wipe-out' area, the *A*, the *B*, and the *C* service areas. The wipe-out area is bounded by the field strength contour of about 30 millivolts per metre. In this area, cutting out the local station is difficult unless very special apparatus is used. In the *A* area the field strength lies between 30 millivolts and 10 millivolts per metre, in the *B* area between 10 millivolts and 5 millivolts per metre, and in the *C* area between 5 millivolts and 2·5 millivolts per metre.

IN an *A* service area defined as explained above the listener is practically certain of an uninterrupted service, and electric trains or trams or X-ray apparatus will rarely affect him. In a *B* service area there is good crystal reception, but in a *C* service area the listener is often at the mercy of outside interference. In London the 'wipe-out' area is roughly a circle of six miles radius, with its centre at the broadcasting station. The space between this and a concentric circle of about 12 miles radius is the *A* service area. A circle of 18 miles radius includes the *B* service area, and the *C* service area is included within a radius of 30 miles. Daventry having a long wave-length attenuates much less rapidly than London. In the future, much higher aerials must be used so as to improve the efficiency of the radiation. To get an even distribution this efficiency must be improved to the utmost. By international agreement Britain has been allotted ten wave-lengths. The author considers that the best way to reframe distribution is to use for the main service fewer transmitters. He thinks that five centres of distribution, each using two wave-lengths, would be the best.

SIXTY per cent. of the total cost of farm produce is chargeable to power and labour; farmers cannot, therefore, afford to neglect any possible means of reducing such costs. Mr. R. Borlase Matthews, in the *Scottish Journal of Agriculture*, vol. 10, p. 271, discusses electricity in farming and gives several striking examples of economy that can be effected by its use. He considers electricity profitable at 8d. a unit for light and 4d. for power, though in many cases, especially where manual labour is at present employed, a considerably higher rate would be found economic. Electric lighting has proved very successful in poultry houses during the winter months, 15-35 per cent. more eggs being obtained at a time when prices are highest, owing to the increased hours of feeding and exercise; bees also have been found to produce 17 lb. more honey per hive per annum when electrically lighted and heated. Electric power is particularly suited to dairy work owing to the special need for cleanliness, and when used for cream separating or other daily operations where manual labour is at present employed, the cost of installation may be recovered in twelve months. Great saving is also obtained by the use of electric milking machines.

MR. MATTHEWS states that hay can be artificially cured by electric power, and has a better aroma and greater nutritive value than the naturally cured product. The hay is cut green or even wet and stacked immediately; air is then driven in through wooden ducts, the moisture and heat evolved being thereby dissipated. The curing depends on temperature control and the arresting of the process at the correct point. Electric ploughing is not yet used as much in Great Britain as on the Continent, but even at its present stage it compares favourably with all other methods of ploughing. Special types of farm buildings are not necessary before electrically operated machinery is installed; in fact electric power is being successfully used in many low buildings in Scotland. Besides the enormous commercial value of the development of electric power in farming, there would result a social service of the first importance, namely, the raising of the standard of life in rural areas.

ADJOINING the Brent Valley Golf Links in the Borough of Ealing is an estate of seven acres, the greater part of the grounds of which have, from being left almost entirely untouched for fifteen years or more, become a recognised haunt of birds, and many species are known to have nested there. The Selborne Society has long wished to protect the ground in question, and at last there is an opportunity of acquiring it. It has been suggested that it would make a fitting memorial to the late W. H. Hudson, who helped the Selborne Society to establish the Brent Bird Sanctuary at Perivale higher up the river. Lord Montagu of Beaulieu, Lord Avebury, and Sir John Otter are making an appeal for funds to form the new bird sanctuary. Donations towards the purchase and maintenance of the property should be sent to the treasurer of the Selborne Society, Sir John Otter, at the Hermitage, Hanwell, W.7.

AN esteemed contemporary, *Chemistry and Industry*, with enviable *bonhomie*, frequently looks out upon the world with a twinkle in its eye—occasionally

with juxtaposition of tongue and cheek—and sees all kinds of delightful things beyond the strict range of its title. Thirty of these glimpses (Dr. Stephen Miall calls them "Chemical Reflections") have been collected and republished by Messrs. Ernest Benn, Ltd., for the entertainment and (or) instruction of a wider circle. The author, although he denies being either a chemist or a writer, has indeed a pretty wit and a sturdy commonsense which give point to his remark (page 21) that "it costs less to read *Chemistry and Industry* than to take stalls to see 'No, No, Nanette.'" Thoughts on an oyster jostle with the coking of coal; holidays (two of them), science and religion in the United States, bad trade, the scope of organic chemistry, the late Labour Government, and one or two outstanding personalities are all 'reflected' as in a mirror, which, to be candid, has not always a plane surface. That, however, naturally makes the reflections all the more amusing.

MR. H. BARKLEY, of the Commonwealth Weather Bureau, read a paper on "Some Correlations between Rainfall and Production in Australia," to the University of Melbourne Agricultural Society, on June 10. Mr. Barkley began with a consideration of area rainfall in Australia; he showed from observations made over a period of years the possibility of ascertaining the frequency distribution of rainfall in any district. He pointed out that a calculation of the probability of rainfall in excess of a certain minimum in one year followed logically from such data; the use of such calculations made the risks of the pastoral industry ascertainable. Turning to the wheat crop, Mr. Barkley showed that in the curve of annual yields there is a steady rise, due presumably to the introduction of superior methods of cultivation, and that the mean curve can be calculated; from this curve there is an 80 per cent. correlation between August-September precipitation and final yield. Crop estimates based on this method have the great merit of being early. In the season 1926–27 they were within 10 per cent. of the yield finally reported. Rains in October and November have some influence on the yield, but chiefly in increasing grain size and water content. Dealing with the pastoral industry, Mr. Barkley showed that grazing capacity per acre is in the western half of the State correlated with rainfall, and that average fleece weight varies in conjunction with that of January and February. In the eastern half of the State, where the rainfall is considerably higher, and in the central district, where hand feeding is frequent, the results are divergent. As regards lambing, observations on certain large estates show the existence of a close correlation between the combined precipitation of January and April and lamb-production.

THE full programme has now been issued of the meeting on Sept. 1-4, at Basel, of the Swiss Society of Natural Sciences. Dr. Fritz Sarasin will deliver his presidential address on Sept. 1, and special lectures will be given by Profs. A. Brachet, L. Courvoisier, L. Duparc, and H. E. Sigerist, as was announced in our issue of June 11, p. 866. The fourteen sections into which the scientific work of the meeting will be divided, together with the names of the sectional presidents, are as follows: Medical biology (Prof. R. Stachelin, of Basel); chemistry (Prof. H. Rivier, of Neuchâtel); physics (Prof. P. Debye, of Zurich); geophysics, meteorology, and astronomy (Prof. S. Mauderli, of Bern); mathematics (Prof. F. Gonseth, of Bern); pharmacy (J. Lang, of Davos); geology (Prof. A. Jeannet, of Neuchâtel); mineralogy and petrography (Prof. M. Rheinhard, of Basel); palæontology (Dr. A. Tobler, of Basel); zoology and entomology (Prof. A. Reichensperger, of Freiburg); general botany (Prof. E. Wilczek, of Lausanne); systematic botany and plant geography; anthropology and ethnology (Prof. R. Zeller, of Bern); history of science and medicine (Prof. G. Senn, of Basel). Excursions of special interest to geologists, petrographers, and botanists respectively have been arranged as well as numerous social functions. The chairman of the reception committee is Dr. J. Roux, Naturhistorisches Museum, Augustinergasse 2, Basel.

THE third meeting, since the War, of the International Commission for the Exploration of the Upper Air is to be held at Leipzig on Aug. 29-Sept. 3. The previous meetings were at Bergen in 1921 and in London in 1925. Sir Napier Shaw is president of the Commission, in succession to Prof. V. Bjerknes; the secretaries are Dr. Th. Hesselberg, director of the Meteorological Institute of Oslo, and Mr. R. G. K. Lempfert, assistant director of the Meteorological Office, London. The local arrangements are in the hands of Prof. Dr. Weickmann of the Geophysical Institute of the University of Leipzig. The principal business of the meeting is to consider ways and means for the re-establishment of the publication of the results of the international co-operation in aerology in continuation of the agreement arrived at in St. Petersburg in 1904 which was interrupted by the War. In accordance with instructions of the Commission, a specimen volume of "Comptes rendus des jours internationaux, 1923," has been prepared, and with the aid of contributions from the Meteorological Section of the International Union of Geodesy and Geophysics, and from other sources, has been printed for circulation. In its main features, the volume follows the precedent of the "Réseau Mondial," an annual volume of observations of pressure, temperature, and rainfall for the globe, which is published by the Meteorological Office, Air Ministry, and dates back to 1910; but the specimen volume contains two new features: first, a folio of maps of the distribution of pressure over each hemisphere on the thirty-six "international days" of 1923; and secondly, a folio of "tephigrams" or representations of the results of observations of registering balloons on the international days expressed as curves referred to absolute temperature and entropy as co-ordinates, and therefore specially expressive of the energy of dry or saturated air in the atmosphere on those days.

THE *Chemiker-Zeitung* of June 22 contains a special supplement dealing with the progress of industrial inorganic chemistry in the years 1924–1926. The review is by no means confined to progress in Germany but extends to other countries. The nitrogen problems are dealt with in very considerable detail. Then follow a lengthy account of progress in the manufacture of dyestuffs during 1926 and a report on synthetic sweetening substances during 1925–1926. The value of these reports is greatly increased by the numerous references to patent literature and to other journals.

THE Report of the National Research Council of the United States for the year ending June 30, 1926, shows that the expenditure of the Council for the year was approximately a million dollars, about a third of which was disbursed for Research Fellowships. These are awarded to candidates who have gained the Ph.D. degree or its equivalent and have shown marked ability in research. For the year 1925–26 the number of fellowships awarded was: in physics 26, chemistry 26, mathematics 11, medical sciences 36, anthropology 4, botany 11, zoology 11, psychology 7, seed germination 1. Others are appointed in co-operation with organisations affiliated with the Council, for research in agricultural and industrial problems. In agriculture 7 fellowships were awarded.

VOLUME 18 of *Contributions from the Jefferson Physical Laboratory* of Harvard University contains reprints of forty-three papers by the staff and students published during the year 1925. Seven of these relate to the effects of high pressure on viscosity, compressibility, or magnetic susceptibility, three to band spectra, ten to X-ray phenomena, three to the Hall and related effects, four are on photo-chemical problems, and several deal with the atom and its structure. About a third of these papers are due to the work of the four National Research Fellows at the Laboratory. Prof. Bridgman's paper on the effect of pressures up to 12,000 atmospheres on the viscosities of forty-three pure liquids is one of the longer papers and forms a valuable addition to the information which is being got together by the Research Committee on Lubrication of the American Society of Mechanical Engineers. A short paper describes the equipment of the Cruft High Tension Laboratory for precision X-ray research, and the volume includes obituary notices of Profs. Sabine and Trowbridge by Profs. Hall and Lyman respectively. No one with this volume before them can doubt the value of the Jefferson Laboratory as a centre for research.

UNDER the will of the late Thomas L. Gray, the Royal Society of Arts is residuary legatee of his estate for the purpose of founding a memorial to his father, the late Thomas Gray, who was for many years Assistant Secretary to the Board of Trade (Marine Department). The objects of the trust are "The advancement of the Science of Navigation and the scientific and educational interests of the British Mercantile Marine." The Council now offers a prize of £100 for a valuable improvement in the science or practice of navigation proposed or invented in the years 1927 and 1928, and a prize of £50 for an essay on "The Practice of Navigation in the Mercantile Marine." The essay must be based on the actual methods used by the writer during his career, with special reference to the instruments used as aids to navigation, and the effect of stowage of cargo on the steering, speed, and safety of the vessel. Essays must be typed or clearly written and must be sent in under a motto, accompanied by a sealed envelope enclosing the author's name. Competitors must send in their essays not later than Dec. 31, 1928, addressed to the secretary of the Royal Society of Arts.

WE have received from Messrs. Brown and Son, of Alembic Works, Holloway, London, N., the fourteenth edition of their catalogue of laboratory apparatus and equipment. The greater part of the volume is devoted to apparatus suitable for industrial research laboratories and the larger technical institutes. Illustrations are given of benches and other fittings supplied to the laboratories of H.M. Government, the Imperial College of Science, the University of Liverpool, etc. Considerable space is devoted to ovens and stills, combined or separate, suitable for large or small laboratories. Electrically heated ovens, vacuum ovens, and high-pressure steam ovens, incubators heated by gas or electricity, centrifuges, explosion cupboards with sliding steel doors, electrical tube and muffle furnaces, mixing machines for stiff pastes, end-runner mills, tilting boiling-pans and cold storage chests will be found in the list. Special features are patent self-sealing autoclaves, designed to withstand pressures up to a thousand atmospheres, rectifying stills for alcohol and other liquids, with capacity ranging from five to fifty gallons, and electrically heated Soxhlet extractors for ordinary laboratory use or for quantities up to twenty gallons of solvent.

READERS interested in early maps and geographical books should see the latest catalogue (No. 498) of Mr. F. Edwards, 83A High Street, Marylebone, W.1, which gives particulars of upwards of 1200 items, some of great rarity. Reproductions of the most interesting maps are given. The catalogue will be sent free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Inspectors of stores for the Indian Stores Department—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Aug. 22). A junior technical officer at the Royal Aircraft Establishment to assist in the experimental development of electrical equipment for use in aircraft—The Chief Superintendent, R.A.E., South Farnborough, Hants (Aug. 27, quoting A.199). An advisory agricultural economist in the University of Reading—The Registrar, The University, Reading (Aug. 27). An assistant inspector of weights and measures in the Weights and Measures Department of the City of Nottingham—The Town Clerk, The Guildhall, Nottingham (Aug. 29). A lecturer in radiology, a lecturer in anæsthetics, a demonstrator

for the prosthesis room, and a demonstrator for the conservation room of the Cairo Dental School—The Director, Dental School, Ministry of Education, Cairo (Sept. 1). An assistant lecturer in mechanical engineering at the Bradford Technical College—The Principal, Technical College, Bradford (Sept. 5). An adviser in agricultural zoology and a research assistant for soil survey work in the department of agriculture of the University College of North Wales—The Secretary and Registrar, University College (Department of Agriculture), Memorial Buildings, Bangor (Sept. 10). A professor of dentistry in the University of Otago, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Sept. 15). An assistant lecturer in physics in the University of Manchester—The Registrar, The University, Manchester (Sept. 20). An assistant lecturer in economics at Auckland University College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2. A junior assistant physicist, under the directorate of radiological research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

CONJUNCTION OF JUPITER AND URANUS.—These two planets reach opposition next month, and are now observable well before midnight. They have been in south declination for many years (six and forty-two respectively) and have now returned to the equator. On Aug. 19 Uranus is 49′ due north of Jupiter, so it is an easy opportunity to identify the former planet. It is visible to the naked eye in a clear sky with acute sight, if one knows exactly where to look.

MAXIMUM OF MIRA.—This remarkable variable star is due to attain its maximum at the end of September; as it will then be nearly opposite to the sun, the conditions for observation will be very favourable. It is already visible to the naked eye, but it is not high enough for convenient observation until after midnight. It will be interesting to compare Mira with neighbouring stars during the next few weeks, and to note its gradual increase in light. The star attains the second magnitude at some maxima, the third at others.

SKY ILLUMINATION DURING THE TOTAL SOLAR ECLIPSE OF JUNE 29.—It has been observed in several eclipses that the recovery of light at the end of totality appears to be far more rapid than its decline at the beginning of it. Miss Catherine O. Stevens, writing from 3 Heron Court, Richmond, Surrey, refers to the total solar eclipse of June 29 in particular, and ascribes the effect to the fact that the shadow cone pierced the atmosphere at an angle so acute that it reached the atmosphere vertically above any locality in advance of its arrival at the place itself, and so caused a good deal of gloom before totality. Allusion has already been made to this effect in NATURE of July 9 in explanation of the fact that the descent of darkness and return of light at Colwyn Bay happened some seconds before the actual beginning and end of totality. It may also have had an effect in causing the return of light to be more rapid than its withdrawal, but in this case the effect ought to be reversed at an evening eclipse, the withdrawal being more rapid than the return. Such an effect is seldom if ever noted. It was certainly not the case at the afternoon eclipse at Algiers in 1900, but in that case the air was so transparent that atmospheric effects would be much less conspicuous.

COMETS.—No further news of Gale's comet has come to hand, and it is to be feared that the object has been lost. It is, however, possible that unreported observations have been made in the southern hemisphere.

Senhor Mello e Simas has published some researches on the conjectured identity of Comet Comas Sola with 1890 VII (Spitaler). He has carried the position of the former back to 1912, when it made a near approach to Jupiter, and finds that it was about four astronomical units from the position of the latter, brought up from 1890, with perturbations by Jupiter up to 1901. He concludes that the two comets are not identical, but this cannot yet be considered as definite; Spitaler's comet was a difficult object in 1890, and the observations were neither numerous nor very exact. It is, therefore, quite possible that its accepted period is sufficiently in error to permit of the two comets being identical. The orbit of comet Comas Sola is much better known, since this has been well observed under favourable conditions for more than half a year; it would seem, therefore, to be the safer course to start from this end, and work back with different assumed periods, to see whether any of them would fit with Spitaler.

L'Astronomie for August contains an article by Mme. Flammarion on comet Pons-Winnecke, with reproductions of two photographs taken by M. F. Quenisset on June 23. The comet appears as a large nebulosity, some 25′ in diameter, slightly extended to the north, that is, towards the sun. The nucleus was of mag. 9. On June 26-27 a tail 1° long was photographed, in P.A. 230°. The comet was easily visible to the naked eye as a small white transparent cloud, not unlike the Andromeda nebula.

Dr. G. Merton has obtained the following photographic observation of comet Grigg-Skjellerup:

July 5·96768 U.T., R.A. (1927·0) $17^h\ 19^m\ 38{\cdot}76^s$, N. Decl. 39° 36′ 27·5″.

He gives the following continuation of the ephemeris (0^h):

	R.A.	N. Decl.	log r.	log Δ.
Aug. 20.	$18^h\ 31^m\ 8^s$	12° 22·7′		9·9290
24.	18 36 12	10 49·7	0·2261	9·9563
28.	18 41 19	9 23·2		9·9830
Sept. 1.	18 46 29	8 3·1	0·2454	0·0090

Search ephemeris for Schaumasse's Comet (from *B.A.A. Jour.*, March 1927, p. 240):

PERIHELION, SEPT. 27·0.

0^h U.T.	R.A.	N. Decl.	log r.	log Δ.
Aug. 22.	$8^h\ 18{\cdot}9^m$	21° 25′	0·1022	0·3206
30.	8 51·6	20 31	0·0898	0·3121
Sept. 7.	9 24·7	19 13	0·0798	0·3055
15.	9 57·7	17 33	0·0728	0·3007
23.	10 30·5	15 34	0·0693	0·2982

PERIHELION, OCT. 5·0.

Aug. 22.	8^h 0·5^m	21° 21′	0·1165	0·3174
30.	8 32·7	20 41	0·1022	0·3071
Sept. 7.	9 5·6	19 39	0·0898	0·2978
15.	9 38·7	18 14	0·0798	0·2911
23.	10 11·7	16 29	0·0728	0·2863

The comet will be low in the north-east just before dawn. It is very desirable to find the comet this year, as the circumstances will be more unfavourable for observation at the next return in 1935.

Research Items.

EARLY MAN IN AMERICA.—In the *Scientific American* for August, Mr. Harold J. Cook returns once more to the question of the antiquity of man in America. He recapitulates the circumstances of the discovery of the Nebraska tooth in the tertiary deposits of the divide between the North Platte and Niobrara Rivers near the Agate Spring Fossil Quarries. These deposits were discovered by the writer and Dr. W. D. Matthew in 1908 and have proved rich in mammalian remains of tertiary age, some showing distinct relationship with Asiatic forms. Fresh discoveries were made year by year until the owner of the land ordered the work to stop. Work by Mr. Albert Thompson, of the American Museum of Natural History, on an adjacent ranch produced from among the remains of a characteristic pliocene fauna evidences of human culture in the form of artefacts of green bone of contemporary animals. Of these implements some are drilled, many shaped or sharpened in various forms, while others have been used for pounding. Such is the result of a preliminary critical study by Prof. Fairfield Osborn and Mr. Thompson. The resemblance of these implements to those of modern Indian workmanship has already been pointed out. In January last investigations were begun on a site farther south at Frederick, Oklahoma, on a ridge of sand and gravels lying on the eroded surface of Permian Period Red Beds. The geological evidence shows that the top of the highest hill in this area was once the bed of a river. It is now one hundred feet above valley level and two hundred and eighty feet above the present Red River. Three periods of deposition on the old Red Bed floor are shown. In Bed A, associated with typical pleistocene animal remains were stone implements made by man, showing a degree of culture comparable with that of the modern Indian nomads of the plains. This evidence would, therefore, support the view that the Indian has changed little over a very long period of time, and meet the arguments of those who refuse a high antiquity to the Indian on account of the modern character of the remains, skeletal or other. This discovery is dated tentatively at a period of 365,000 years ago and affords the most conclusive evidence of Glacial Age man yet found in America.

CANCER AND ITS TREATMENT.—The Irish Radium Committee has issued its Report, compiled by Dr. Walter Stevenson and Mr. Maurice Hayes, on the treatment of cases of cancer by means of radium and radium emanation during the year 1926. A large proportion of the cases was unfortunately at an advanced stage and a palliative effect only could be hoped for: in this respect the treatment is attended with considerable success. In a small number of cases, with or without operation, the treatment has apparently effected a cure. Rodent ulcer is particularly amenable, and certain non-cancerous conditions, such as ulcers, local sepsis, sciatica and others, were much benefited (*Sc. Proc. Roy. Dublin Soc.*, vol. 18, No. 39, 1927, p. 443). The Ministry of Health has issued a Report by Dr. Janet Lane-Claypon on a statistical inquiry into the results of treatment of cancer of the uterus (*Reports on Pub. Health and Med. Subjects*, No. 40). The Report is based on the examination of data published prior to March 1926, contained in 848 articles derived from sixteen different countries and dealing with some 80,000 cases of the disease. The principal findings are (1) that patients do not seek advice until an average period of 6-9 months has elapsed after the first occurrence of symptoms, (2) that rather less than half the patients who then apply for treatment are at a stage at which effective operation is practicable, (3) that the results of operation at an early stage of the disease are roughly twice as good as those in patients whose disease is still practicable for operation but who apply late, and (4) that cancer of the cervix is not more serious in younger than in older women.

MINERS' AND QUARRYMEN'S PHTHISIS.—Inhalation of dust containing sharp particles of silica or quartz induces in those subjected to it either a condition of fibrosis of the lungs or the same condition complicated with tuberculous infection—the true miners' phthisis. The last-named variety in the Rand mines has been the subject of a study by Mr. Mavrogordato. Down to 1905 the dust particles in the air of the mines averaged 150 mgm. per cubic metre of air, with a phthisis incidence of 30 per cent. Since then, by the compulsory use of certain measures, the dust particles were reduced to 20 mgm. in 1911, to 5 mgm. in 1913, and to 2 mgm. in 1921, with a fall in the phthisis incidence to 14 per cent. in 1915, 10 per cent. in 1916, and 3 per cent. since 1921 (*Publications of the S. African Institute for Med. Research*, No. 19, 1926). A similar effect from the inhalation of quartz particles derived from slate dust is apparently seen in the high incidence of phthisis among the slate workers in the Gwyrfai Rural District of Carnarvonshire, which is the subject of a Report by Dr. T. W. Wade to the Ministry of Health (*Reports on Pub. Health and Med. Subjects*, No. 38, 1927). The phthisis death-rate among the slate quarrymen and workers of Gwyrfai reaches a maximum at about sixty years of age, being then about 8 per 1000, whereas the general death-rate for males from phthisis in England and Wales at that age is only about 1.25 per 1000. Males other than slate workers of Gwyrfai of the same age have a phthisis death-rate only a trifle more than that for England and Wales.

MIGRATION IN APHIDES.—In *Science Progress* for April and July, Dr. J. Davidson, of the Rothamsted Experimental Station, discusses the biological and ecological aspects of migration in aphides. True aphides of the family Aphididæ (as distinct from the Phylloxeridæ) may be separated into non-migrating species, whose whole life-cycle is spent upon one type of plant, and migrating species. In the latter case one portion of the life-cycle occurs on one type of plant (primary host) on which the fertilised eggs are laid, while the remainder of the life-cycle consists only of parthenogenetic generations which occur in association with other types of plants (intermediate hosts). The primary hosts are trees or shrubs, while the intermediate hosts may be herbaceous plants or other trees and shrubs. The complete life-cycle is practically confined to species occurring in temperate climates. In warmer countries such as Formosa, Java, and the southern United States the sexual phase is frequently suppressed, and continuous parthenogenetic reproduction is the rule. The migrating habit seems to have developed in relation with changes in the world's flora. Those species which are primarily non-migrating, such as members of the tribes Lachnini and Callipterini, exhibit certain primitive characters. The migrating species, on the other hand, exhibit varying degrees of specialisation in habit and form correlated with the extent to which the migratory habit has developed. In general, those species associated with herbaceous plants represent the most recent development in aphid evolution.

THE CONTROL OF THE TSETSE-FLY.—In the *Bulletin of Entomological Research* for June 1927, Drs. Ll. Lloyd, W. B. Johnson, and P. H. Rawson have an important paper dealing with experiments in the control of the Tsetse-fly in Northern Nigeria. An interesting experiment was carried out in which wild game was excluded from a good secondary focus of Tsetse-fly by means of a strong fence. This set up a state of starvation in the case of the species *morsitans* and to some extent in *tachinoides*. There was marked reduction in abundance of both species of the Tsetse, especially of *morsitans*. It is considered that game destruction, if it could be effectually accomplished, would lead to the disappearance of the latter species, but not *tachinoides*. It is for this reason that a policy of game destruction is not recommended; it is suggested, on the other hand, that a policy of *laissez-faire* towards the game in Northern Nigeria so that the increase of wild Ungulata is checked, would tend to restrain the increase and spread of the Tsetse. A successful experiment in deferred grass burning is described. The late sweeping fire was found to result in a great mortality of the flies and their pupæ in both the species of Tsetse. It scarcely affected the growth of established thicket, but probably checked the expansion of such and the formation of new thicket. It is considered that late grass burning, well organised, might have a good effect in Tsetse reduction in Northern Nigeria, but there are great difficulties involved.

ANIMAL LIFE IN HOT SPRINGS.—Prof. C. T. Brues has summarised (*Quart. Review of Biology*, vol. 2, No. 2, 1927) the main facts relating to animal life in hot springs. Thermal waters contain only a small amount of dissolved oxygen and they are often impregnated with salts in solution, usually either calcium carbonate or silica. Compared with plants, animals have considerably less power of adjustment to high temperatures, and even the most resistant forms of animal life are unable to endure the degree of heat at which certain plants thrive. Of the insects which occur in hot springs the author refers to beetles, some of which have been reported from water at 115° F., and to the larvæ of Chironomus, which he found abundant in the mud of a shallow thermal pool at a temperature of 120° F. in Yellowstone Park. A few Crustacea have adopted a thermal habitat, *e.g.* species of Gammarus and of Cyclops and an isopod (Exosphæroma). This last is especially interesting, because a closely related extinct genus is preserved in hot spring deposits of lower Oligocene age, indicating a long thermal ancestry. Molluscs such as Physa and Limnæa are also known to inhabit hot springs. Tadpoles of a frog were found in Yellowstone Park in water at a temperature of 104°–106° F., that is, several degrees above the temperature at which unacclimatised tadpoles of the frog and the toad die.

PLANKTON PRODUCTION.—There is an obvious need for some quick method of estimating the production of plankton in the sea to supplant the present laborious process of counting the diatoms themselves. It seems possible that such a method may be found in a study of the oxygen content of sea-water and its relation to the photosynthesis of the diatoms present. To this end preliminary observations were carried out by T. Gaarder and H. H. Gran in an investigation of the production of plankton in the Oslo Fjord in 1916 and 1917 (*Cons. Internat. Rap. et Proc. Verb.*, **42**, 1927). Hydrographic and plankton observations were made, and at the same time, by suspending flasks of sea water with its contained plankton at different depths, artificial cultural experiments were set up. Results obtained in the open waters could not be regarded as conclusive on account of the constant changing of the water masses in the fjord brought about by currents. In the flasks the greatest reproduction among the diatoms in March took place at 2 m. and 5 m., and there was still sufficient increase at 10 m. for the oxygen output to balance the uptake through respiration. In March the necessary nutritive substances occurred in the sea water in sufficient quantities in proportion to the consumption by the diatoms, but in September they were insufficient to produce a profuse development of diatoms. Addition of phosphates and nitrates to the water in the flasks in September caused a rapid production of 100,000 cells per litre in 3 days.

PLANT CHIMÆRAS.—Numerous chimæras have been produced by Messrs. Jorgensen and Crane (*Jour. Genetics*, vol. 18, No. 2) in Solanum, using the well-known methods of Winkler. The species grafted together were *S. lycopersicum*, *S. sisymbrifolium*, *S. luteum*, *S. nigrum*, and *S. guineense*. These species have different multiples of twelve chromosomes, as Winkler originally showed for some of them, so that the parental tissues can be identified in the chimæra by means of the dividing cells. A new result is the discovery that in many forms, which were regarded as sectorial chimæras only, the superficial layers of a sector belonged to the other species. Such forms are really incomplete periclinals, and it is proposed to call them mericlinals. The morphology of the various chimæras is described, and it is shown that the periclinals generally show somatic instability, reverting to the pure form which forms the core. In one case, however, in *S. lycopersicum-luteum*, in which there were probably three or four outer layers of *luteum*, reversion took place through transitional stages to the pure *luteum*.

CHROMOSOME ATTRACTIONS IN PLANTS.—The arrangements of the chromosomes at reduction have been studied by Dr. Belling (*Jour. Genetics*, vol. 18, No. 2) in Datura and other plants, especially in triploid, trisomic, and haploid plants. In haploid individuals the chromosomes show no mutual attractions. In diploids, corresponding ends of chromosomes attract each other, while the two ends of the same chromosome show different attractions. Long chromosomes may also show attractions at other points. From a study of triploids in which trivalent chromosomes are formed, the three members show the five expected arrangements. The fact that the triangle configuration does not normally occur indicates that the attractions of the two ends of a chromosome are different. On this hypothesis, eight configurations would be expected in tetraploids and they have been found. The trisomic ($2n + 1$) mutations of Datura give rise to certain secondary forms in which one of the chromosomes of the trivalent has the same attraction at both ends and consequently forms a small circlet. It is suggested that this has arisen through crossing-over in the middle between two homologous chromosomes lying parallel but with reversed orientation. There is also a suggestion of crossing-over between non-homologous chromosomes, producing an isomorphic strain which in crosses combines to form a ring of four chromosomes. These are further steps in showing that genetical variations have a cytological foundation.

TERTIARY CEPHALOPODA FROM JAPAN.—Cephalopod remains are rare in the Tertiary rocks of Japan, only three species having hitherto been described. Two new forms, *Aturia aturi*, var. *tokunagai*, and *Nautilus* (*s.s.*) *japonicus*, are now added to the list by S. Shimizu, whilst a species hitherto identified with *Aturia zigzag* has been given separate rank as *A. yokoyamai* by

T. Nagao (*Science Repts., Tôhoku Imp. Univ.*, Sendai, Ser. 2, vol. 9, No. 2). Excellent plates accompany both papers.

INDIAN TERTIARY MOLLUSCA.—In 1909 the first part of Cossmann and Pissarro's work on the Mollusca of the Ranikot Series, comprising the Cephalopoda and Gastropoda, was published in the *Palæontologia Indica* (New Series, vol. 3, pt. 1). The second portion on the Brachiopoda and Lamellibranchiata (with some species from the *Cardita beaumonti* beds) has now, after many vicissitudes, been issued (*Pal. Ind.*, New Ser., vol. 6, mem. 2). A translation was made by the late Dr. E. Vredenburg from the original French and the two MSS. sent to M. Cossmann for revision in 1915, but were lost without trace, probably sunk with other mails. Fortunately a duplicate translation was found among Dr. Vredenburg's literary remains, and from that the present part has been prepared. One brachiopod and twenty-five lamellibranchs, nine of which belong to the Cretaceous *Cardita beaumonti* beds, are described, including eighteen believed to be new species, and figured on four plates.

OIL IN AUSTRALIA.—The vexed question of petroleum in Australia is once again mooted by the appearance of another report, this time dealing with portions of the Kimberley Division of West Australia, with special reference to the possible occurrence of mineral oil in the Fitzroy Basin, and written by Mr. T. Blatchford, Assistant State Mining Engineer. While we have nothing but praise for the painstaking efforts and perseverance of the many experts in their search for petroleum in this continent, the prospect of ultimate location of commercial oil-pools, especially in the West, seems inevitably slight, if on first principles alone, and a perusal of this report of another possible area does not incline one to a change of opinion. In the present instance the most likely beds would seem to be those of Cambrian age, with which some discovered bitumen outcrops are apparently connected, more particularly the Upper Cambrian beds overlying basalt flows. The author states that suitable structures exist in the area, and other conditions are favourable, though proving the presence of oil will necessitate boring probably to 4000 or 5000 feet. Two trial borings through similar rocks in a contiguous district, at Mt. Wynne and the Ord River Basin, were unsuccessful, the Mt. Wynne boring being abandoned at 2400 feet without meeting oil-bearing beds, the Ord River bore being shut down in basalt.

PHOTOMETRIC MEASUREMENTS DURING THE TOTAL SOLAR ECLIPSE OF JUNE 29.—During the total solar eclipse on June 29, Mr. J. S. Dow made many photometric observations of the total illumination. Although he was not quite in the centre of the belt of totality, he was favourably situated to observe the phenomena. He had previously made photometric observations of the partial eclipse of 1912 under excellent weather conditions and so knew exactly what to expect. He publishes his results in the *Illuminating Engineer* for August. When he began his observations about 5.20 A.M. the sky was clearing of clouds. This led to an actual increase in illumination notwithstanding that the eclipse had begun. At 6.10 the sun emerged from the cloud as a watery crescent, but it disappeared again just before totality and did not appear again until totality was over. At totality the illumination fell with great rapidity for a few seconds and then rose with equal rapidity. The lowest illumination recorded was about half a a foot candle. It then rapidly rose to more than 2000 foot candles, due partly to the passing of the eclipse and the fact that the altitude of the sun was increasing. Owing to the clouds it was impossible to forecast accurately what the illumination would be, but the agreement between calculated and observed values in the 1912 eclipse was excellent. Apparently values of the illumination so low as a fiftieth of a candle foot were obtained by an observer at Southport. It is practically impossible at present to predetermine the illumination resulting from a total eclipse. It would be necessary to have accurate data of the candle power of the corona. Quite apart from the interference of clouds, the illumination probably varies with the width of the band of totality and the position of the observer on it.

A NEW SOURCE OF ARSENIC.—A paper has been published by R. E. Remington in the *Journal of the American Chemical Society* for June directing attention to a hitherto unsuspected source of arsenic in the human body. The author has examined a large number of brands of smoking and plug tobacco by means of the micro-Marsh method, and has found amounts varying from six to thirty parts per million. These are many times in excess of the quantities permitted in foods. Nearly half of the arsenic in smoking tobacco is evolved in the smoke and about half of the arsenic in plug tobacco is soluble in water. The results show very clearly that a considerable part of the arsenic in tobacco may find its way into the body, and experiments are now being carried out to test this possibility conclusively.

THE PASSIVITY OF METALS.—The unusual properties of iron and other metals which have been rendered passive by oxidising treatment have been attributed by many investigators to a protective film of oxide or other material. This explanation has been rejected by some chemists, since no film is usually visible, while iron which has been covered with a visible film by heating is often not passive. The presence of very thin films, too thin to give interference tints, has been proved by the work of U. R. Evans, which has been published in the May issue of the *Journal of the Chemical Society*. He has found it possible to render these films visible by dissolving away the metal below them by anodic treatment or by means of iodine. The envelope of the iron electrode after anodic treatment consisted of two thin transparent parallel membranes of ferric oxide united at the two edges. There seems to be little doubt that this film is the cause of passivity; where the film is broken or contains cracks the metal is active.

FOG PRODUCTION ON THE NEUTRALISATION OF HALOGEN HALIDES.—It has been noticed that when a current of air containing phosgene or phosphorus oxychloride is passed through charcoal and aqueous alcoholic potash, a fog develops in the vessel containing the alkali as soon as the charcoal is saturated. H. O. Askew has shown that both hydrochloric and hydrobromic acid vapours when passed into various alkaline solutions are capable of producing similar effects, more especially in the presence of colloids and dyes. A complete investigation of this subject is described in the *Journal of the Chemical Society* for May. It has been found that the relation between the amount of fog produced and the alkali concentration, and also the amount of fog and the concentrations of the added active materials, are of the same form as the adsorption isotherm. The concentration of the acid in the fog particles and the water vapour pressure are constant and independent of the amount of fog formed, but the sizes of the particles decrease as the fogs become denser. The particles appear to have no electrical charges.

The Leeds Meeting of the British Association.

PROGRAMMES OF SECTIONS.

THE arrangements for the ninety-seventh annual meeting of the British Association are now assuming final form, and the Local Committee at Leeds is confident that the meeting will be a success. Members are assured of a cordial welcome both from the City of Leeds and the University, and the programme of entertainments outside the Section rooms is an attractive one. The Lord Mayor and the University are giving receptions; garden parties are arranged; while for those who take more vigorous amusement a dance will be held. On the evening of Sunday, Sept. 4, the Leeds Choral Union will give a concert in the Town Hall, to which all members are invited. The programme includes: Pianoforte Concerto (Grieg), "The Dream of Gerontius" (Elgar).

In the Crypt of the Town Hall there is to be an exhibition of scientific instruments and apparatus; while near the Reception Room the Meteorological Department of the Air Ministry will have an office for weather forecast work. The B.B.C. is demonstrating the educational possibilities of wireless; and Mr. J. L. Baird, of the Baird Television Company, is undertaking to demonstrate television between London and Leeds during the latter part of the meeting, whilst during the first three days he will give demonstrations of nocto-vision and members will have the opportunity of seeing a phonoscope.

Though a large industrial city with a 'smoke' problem, Leeds is a splendid centre for excursionists; and in order to meet their requirements the Local Excursions Committee has arranged a large number of attractive visits led by experts to the neighbouring country. The handbook of excursions, to be issued to each member, will be a book of permanent value to those who are interested in the district around Leeds. We have already mentioned that, thanks to the kindly offices of the Yorkshire Ramblers' Club, a number of members will be able to make the descent into Gaping Ghyll, and this will certainly be a very unusual excursion of any British Association meeting. Another excursion novelty is that to Doncaster to witness the 'St. Leger' as the guests of the Doncaster Corporation. York and Harrogate have also made preparation for the visit of a number of members; works and factories have extended invitations to members to make inspectional visits; and a number of descents into coal mines are planned. Those interested in art should not miss the opportunity of seeing the fine collection of Turners at Farnley Hall. A number of sectional excursions has also been arranged.

The list of foreign guests attending the Leeds meeting includes the following: in the department of the mathematical and physical sciences, Prof. Robert A. Millikan (Pasadena, California), Prof. Peter Debye (Zürich), Dr. W. Kolhörster (Charlottenburg), Dr. W. Heisenberg (Copenhagen); in chemistry, Prof. Dr. H. Freundlich (Berlin); in zoology, Dr. S. Kopeé (Poland); in economics, Prof. J. Schumpeter (Bonn); in botany, Prof. Nils E. Svedelius (Upsala), Prof. Dr. E. von Brücke (Innsbruck), Dr. John P. Lotsy (Velp, Holland); geology, Prof. G. Delépine (Lille), Prof. G. A. F. Molengraaf (Holland).

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES).

UNDER the presidency of Prof. E. T. Whittaker, an exceptionally interesting programme has been arranged in Section A (Mathematical and Physical Sciences). Prof. Millikan is speaking on the spectra of the elements of the first row of the Periodic Table, and is also giving an evening lecture to the Association on cosmic rays. Dr. Kolhörster will also speak on the latter subject in the sectional meeting. A paper by Dr. Heisenberg on recent progress in quantum mechanics will be followed by a discussion in which Mr. R. H. Fowler and other English workers will take part. Members will also have the opportunity of hearing Prof. Debye speak on the polar properties of molecules.

Prof. Whiddington is to give an afternoon lecture on the luminous discharge in rare gases, which will include experiments illustrating his own researches, while the papers to be given by Dr. Aston and Prof. Barkla are of special interest at the present time.

The joint discussion with Section B (Chemistry) on the structure and nature of colloidal particles will be opened by Sir William Bragg. There will also be several subsectional meetings. In mathematics a paper by Prof. Turnbull on non-commutative algebra will serve as a useful introduction to the discussion on quantum mechanics, and, in addition to papers by Profs. Milne and Brodetsky, a morning will be devoted to contributions on the theory of numbers.

SECTION B (CHEMISTRY).

THE main activities of Section B (Chemistry) will be devoted to three discussions. On Thursday, Sept. 1, the president, Dr. N. V. Sidgwick, instead of formally reading his address, will open a discussion on "Co-ordination Compounds." Dr. Sidgwick is a recognised authority on this subject, which now occupies an important place in our knowledge of the constitution of chemical compounds. Prof. G. T. Morgan and Dr. S. Sugden, who have made important contributions to the subject, will be amongst those taking part. The joint discussion with Section A on "The Structure and Formation of Colloidal Particles" on the following day should prove particularly interesting. Sir William Bragg, Prof. H. Freundlich of the Kaiser-Wilhelm Institut, and Prof. R. W. Whytlaw-Gray are taking part. Prof. G. Barger will open the discussion on Sept. 5 on "The Chemistry of the Hormones." Profs. H. S. Raper, J. Mellanby, J. C. Drummond, and E. C. Dodds will also discuss these substances, the knowledge of which has recently been greatly extended by the elucidation of the chemical constitution of thyroxin and recent extensive researches in physiology and biochemistry. The morning of Sept. 6 will be devoted to the reading of miscellaneous papers, when Profs. H. M. Dawson, John Read, and others will describe progress made in recent investigations. Throughout the meeting, excursions of special chemical interest have been arranged through the kind co-operation of a number of chemical manufacturers and research associations in and near Leeds.

SECTION C (GEOLOGY).

THE country round Leeds is of special interest at the moment to the geologist conversant with rocks of Carboniferous age, but these rocks and the problems associated with them do not absorb all the attention of Section C. The programme of the Section is a full one; full not only of topics for discussion in the meeting room, but also of visits to places of interest in the neighbourhood where certain of these topics may be further considered in the field. Every branch of the subject is represented in the

programme—physical and stratigraphical geology, palæontology, and petrology—while within the purview of each there are papers of interest to the general reader and others which will be of greater moment to the specialist. Several of these latter communications may also have an economic value in the coalfields and in the exploration for metallic ores.

The geologist, however, considers the conditions in past times as well as those at present existing, and opportunities for speculations of this character are supplied by various authors of papers. It were perhaps invidious to select any papers for special mention, but one such discussion of a general nature may be indicated—climates of the past. The subject is by no means novel at British Association meetings, but it is one which may be studied at intervals with profit. Recent researches in geophysics, meteorology, geology, and biology have shed new light on the matter, and an examination of this new evidence should be very helpful at the moment. The relative values of these discoveries may be more easily ascertained in the course of such a discussion than would be possible in other circumstances.

Reference has been made to field excursions. These will take place each afternoon, and in addition two whole-day excursions to cover a wider range of country are arranged for the week-end included in the period of the Leeds meeting. The field expeditions form a most important part of the programme of Section C, as they provide opportunity for more intimate discussion than does the lecture room. They also afford greater chances for the junior workers to meet with the more senior people and enable difficulties to be voiced which the greater and wider experience of the senior workers may help to dissipate. In this connexion it will be well to note that the numbers attending these excursions are to be limited in most cases, and a ballot for places may be necessary. Early application to the secretaries is therefore advisable.

SECTION E (GEOGRAPHY).

POLAR regions have of recent years assumed a special significance in various fields of earth science. In geophysics and biology, the lands and waters of high latitudes have, by reason of their position, an importance which justifies extended research in these still somewhat inaccessible areas. Problems of polar geography form the theme of the presidential address by Dr. R. N. Rudmose Brown, whilst special papers on Greenland and Iceland deal with physical conditions in relation to settlement and development.

Each year brings new evidence of man's triumph over Nature, or rather of man's increasing use of applied science for the extended exploitation of the resources of Nature. The reclamation of the Zuider Zee, which Dr. Jansma will discuss, is outstanding in this respect, whilst even the remarkable physiographic feature of the Great Barrier Reef, the subject of a paper by Sir Matthew Nathan, may one day have an economic value.

The trend of much geographical research in Great Britain has been steadily in the direction of regional interpretation. This finds expression not only in the series of papers on the Leeds region contributed by Dr. C. B. Fawcett and his school, but also in a number of detailed studies of village communities in the Channel Islands, in the mid-Trent valley and in Yorkshire. Physiographic influences, even where they no longer operate, have often left an abiding impress. It is well, however, that other factors contributing to regional definition should occasionally be thrown into strong light, and this is suggested in a paper by Dr. Vaughan Cornish, in which he discusses the fixation of linguistic boundaries by national adoption of Christianity during the Middle Ages.

SECTION G (ENGINEERING).

THE presidential address to be given by Sir J. B. Henderson to Section G (Engineering) will deal with invention and its dependence upon science. The remainder of the sectional programme includes a variety of subjects of scientific and engineering interest. Dr. T. Stanton and Sir W. B. Hardy are to introduce the subject of lubrication, a topic of great scientific and practical importance. Dr. Lander, Prof. Cobb, and Prof. Wheeler will read papers on various aspects of the coal supplies of Great Britain and their utilisation; a discussion will follow, and it is expected that a number of speakers will contribute interesting matter. This discussion will be followed by a paper describing attempts to utilise the internal heat of the earth for power production.

One morning session is to be devoted entirely to papers dealing with the science and practice of electrical engineering. The important questions of supertension cables and switchgear for the transmission and control of large powers are to be discussed; the new jet wave rectifier for the conversion of A.C. into D.C. by means of a jet of mercury, and particulars of a large-scale plant at present in operation, will be described. A new voltage regulator, in which a valve is used to control the voltage of a D.C. generator supplying current to a laboratory, is to be described; the subject of metallic filament lamps and certain researches in connexion with them will be discussed.

Papers dealing with the limits of efficiency of internal combustion engines, the transmission of power by belts, a new type of pump, and with many other civil engineering problems are promised. Excursions to engineering works of various kinds in the neighbourhood of Leeds have been arranged.

SECTION H (ANTHROPOLOGY).

SECTION H (Anthropology) presents a list of papers which, if not so full as usual, is not less varied. In physical anthropology several communications are of interest to educationists and those in charge of the physical culture of children of school age as well as to anthropologists: Dr. A. H. Mumford will deal with anthropometric observations in relation to school progress; Dr. R. A. Fisher's study of triplets, an investigation undertaken with the assistance of funds provided by the Association, breaks new ground and incidentally brings out deficiencies in our knowledge of the physical characters of the normal child population; and Miss McInnes' ethnological survey of Sheffield and the surrounding districts is based to a great extent on observations of school children and serves to confirm and extend our previous knowledge of the population of Yorkshire. Prof. T. H. Bryce will describe skeletal remains of Viking age from Caithness. An attempt at correlating racial, social, and religious factors will be made by Mr. J. E. Daniels in a communication dealing with Wales. Sir W. Boyd Dawkins will carry further his study of early man and his precursors in the Tertiary period.

A meeting in the north of England affords an exceptionally favourable opportunity for a survey of recent progress in research in the Roman period. In this field communications dealing with Scarborough, York, and Cawthorn will be received from Messrs. Collingwood, Miller, and Richmond. Dr. Oswald will give an account of his excavations at the Roman Camp of Margidunum on the Fosse Way. A second paper by Prof. T. H. Bryce will discuss the

theory of 'Archaic culture' in relation to Scotland. Mrs. Cunnington will describe the unique type of prehistoric monument to which she has given the name 'Woodhenge,' and Dr. Clay will discuss the evidence for the overlap of the Bronze into the Iron Age in Britain. Messrs. Tratman and Taylor will describe the archæology of the Mendips and the Wye valley respectively as the result of excavations carried out by members of the Spelæological Society of the University of Bristol. Dr. T. Ashby supplements the conclusions of his presidential address of two years ago by further evidence relating to the Roman system of communications in the Valley of the Tiber.

An important and, it is hoped, fruitful discussion will be opened by Dr. H. Frankfort dealing with the question of the early prehistoric painted pottery of the Near and Middle East, which has been found to have a wide distribution in very early times. Of a number of papers in ethnography, mention can be made only of Dr. J. H. Hutton's illuminating study of the significance of head-hunting in the Naga Hills and Mr. G. R. Carline's communication on "Primitive Looms." This latter paper is preparatory to an inspection of the collection of looms at the Bankfield Museum, Halifax, which the members will visit on the afternoon of the same day, at the invitation of the Museum Committee.

Section I (Physiology).

Dr. C. G. Douglas is devoting his presidential address to "The Development of Human Physiology." For too long the eyes of the experimentalist have been fixed on the 'laboratory animal'—usually the frog—while the clinician has become more and more impatient of the scanty and academical 'truths' offered to him by his laboratory colleague. Of recent times, however, it has become the practice of certain medical schools and research departments to use man himself as the subject of observation and experiment. The apparatus involved tends to be more costly, the technique is frequently more difficult, but the results amply justify the trouble involved.

Prof. H. S. Raper's contribution is especially welcome, in that it promises a simplification of the current views about oxydases. It seems that the time is passing at which a new oxidation is satisfactorily explained by postulating a new enzyme.

There will be presented to the Section the report of the committee appointed last year to consider particularly the classification of colour-blindness. The signatories comprise Sir Charles Sherrington, Prof. H. E. Roaf, Dr. Edridge-Green, and Dr. Mary Collins. There can be no doubt that agreement about terminology is necessary for progress in this matter, and it is to be hoped that the suggestions of this committee will meet with wide acceptance. Other contributions of interest include papers by Dr. W. Cramer on the available supply of vitamin A in relation to the demand, by Prof. J. C. Drummond on the vitamins of yeast, and by Prof. R. J. S. McDowall on the physical concomitants of mental stress, while there is to be a discussion on the circulation rate, with particular reference to its measurement in man.

Section J (Psychology).

The programme of Section J (Psychology) is almost equally divided between topics of general interest and those of obvious practical significance, medical, educational, and industrial. Dr. William Brown's presidential address on "Mental Unity and Mental Dissociation" will probably reflect his own philosophical, psychological, and medical interests. Dr. T. W. Mitchell, the editor of the *British Journal of Medical Psychology* and a prominent figure in the Society for Psychical Research, will contribute a paper on "Phenomena of Mediumistic Trance."

Two joint discussions have been arranged, one with Section F (Economics) on "Innate Differences and Social Status," the other with Section L (Education) on "The Psychology of Special Scholastic Disabilities." Among the papers of educational interest is one by Prof. C. W. Valentine on "The Comparative Reliability of Intuitive Judgments in Men and Women," and another by Dr. L. Wynn-Jones on "Children's Appreciation of Wit." Representatives of the Industrial Fatigue Research Board and of the National Institute of Industrial Psychology will speak on "Time and Motion Study," "Certain Aspects of Accident Causation," and other psychological topics of industrial importance.

We regret to record the death of Dr. Henry Rutgers Marshall of New York, the well-known author of "Pain, Pleasure, and Æsthetics," who had accepted the Council's invitation to attend the meeting as a distinguished guest. The abstract of the paper he intended to read on "Self-consciousness and the Self" will be printed in the Journal and Annual Report and read by his friend Dr. C. S. Myers.

The Section has accepted a cordial invitation from Messrs. Rowntree and Co. of York to visit their works on Tuesday afternoon, Sept. 6, for the purpose of seeing their methods of selecting and training their workers.

Section L (Educational Science).

Meetings of the Educational Science Section will be held at the Albert Hall on Sept. 1, 2, 5, and 6, under the presidency of Her Grace the Duchess of Atholl, M.P. The president will give her address on Friday, Sept. 2, at 12 noon, on "The Broadening of the Outlook in Education," a subject which will no doubt attract a large audience. On the same day, at 10 A.M., a discussion on "Education in Tropical Africa" will be opened by Sir Theodore Morison with a paper entitled "An Educational Policy for Tropical Africa." Other papers will be contributed by Mr. Rivers Smith ("Education of the African Chief"), Mr. Norman Young, Major A. G. Church, and Miss S. Burstall.

On Thursday, Sept. 1, there will be a joint discussion with the Psychology Section on "The Psychology of Special Scholastic Disabilities." Miss G. Hume, Miss I. Wheeler, and Miss A. H. McAllister will contribute papers on reading, arithmetic, and special disabilities respectively, and an open discussion will follow.

A full session will be given to the subject of "Educational Need of Industry" on the morning of Sept. 5. Mr. J. Wickam Murray will open with a paper on "New Outlooks"; Mr. E. Walls will deal directly with the "Educational Requirements of Industry"; and Mr. J. H. Everett, Dr. H. Schofield, and Mr. A. P. M. Fleming will discuss "Facilities offered by Technical Colleges," "Engineering Training," and "Non-conventional Types of Education in Industry" respectively.

"School Examinations," a subject of much discussion at the present time, will be considered on the morning of Sept. 6. Dr. P. B. Ballard, Dr. J. M. Crofts, Mr. B. C. Wallis, and Mr. J. H. Arnold will contribute papers from different points of view, and an open discussion will follow. In the afternoon of Monday, Sept. 5, Sir Henry Hadow will preside at a demonstration of the work of the Leeds Schools Music and Drama League. He will open with a short address and an interesting programme will follow.

Tidal Predictions by Mariners.[1]

THE publication of the fourth edition of Part 2 of the Admiralty Tide Tables may well be regarded as a memorable event in the history of practical aids to navigation. The first edition was published in 1858, reprinted annually with amendments and additions until 1909, and subsequent editions were published in 1910 and 1920. Though each edition was an improvement on that which preceded it, the type of information and the method of using it remained in all essentials unchanged. The tidal data were presented in the form associated with the names of Whewell and Lubbock, who were mainly familiar with the comparatively simple types of tide experienced in British waters.

Up to a point, it was sufficiently accurate to state that the high water follows the moon's transit by an interval which is approximately a constant at a given place. Such constants have hitherto been the chief aid to navigation in ports for which no daily tidal predictions are available. In many instances it was possible to supplement this method by the use of 'tidal differences'; thus if daily predictions were available at a 'standard port,' then small corrections on time and height could be applied to give fairly good approximations to tidal movements at a neighbouring subsidiary port. If the tidal height at a given hour of the day was required, then tables and diagrams were used, the arguments being (1) the time interval between that hour and the time of high water, (2) the range of tide.

The latest edition supplements this information by the harmonic constants of the principal tidal constituents for about a thousand ports, and very strong reasons are given for the use of these constants. It is even indicated that the non-harmonic constants will ultimately be omitted, and mariners are therefore advised to become familiar with the new methods. It remains to be seen whether the process of conversion will be easy, as mariners do not take kindly to new ways of doing things.

The reasons given for the change are of course entirely connected with the degree of accuracy required. The tidal oscillation is composed of a very large number of constituents which may be broadly divided into two main groups, semidiurnal constituents and diurnal constituents. The non-harmonic tidal constants and the tidal differences can only be functions of either the semidiurnal constituents or of the diurnal constituents. It is not possible to include both diurnal and semidiurnal constituents in the same constant or difference, and the constants hitherto given have practically been functions of the semidiurnal constituents only. More strictly, they are functions only of the constants of particular constituents, inasmuch as the effects of changing phase and distance of the moon are not included, though corrections can be made for these conditions. The tidal differences are more general than the constants, as the variations due to phase and distance are included in the predictions for the standard port. In any case where the diurnal tide is not wholly negligible, large errors are possible, and the error increases with the relative magnitude of diurnal and semidiurnal tides. In general, the non-harmonic constants and differences are of little value outside the Atlantic Ocean.

For heights of tide at times other than high water, the tables and diagrams assume that the tidal oscillation is simply harmonic. This is never the case where there is diurnal inequality and is very rarely the case for ports situated in relatively shallow water.

The harmonic method, however, is uniformly applicable, and its results in general are of very much greater value than those of the non-harmonic methods. The computations required are not excessive, and are facilitated by explicit instructions and tables. Carefully worked examples are given, and it is difficult to see how misunderstanding can occur. The tables to assist predicting are well set out, and the whole work is straightforward and within the powers of any intelligent man. No knowledge of tidal theory is required. The harmonic constants have been given in such a form that the predictions are automatically rendered in the standard time kept at the place, a feature which is unique to the present publication. Since the values of mean sea-level with respect to chart datum are given, the mariner can readily obtain the actual depth of water available; other recent publications of harmonic constants have omitted this important quantity.

Approximate methods of harmonic tidal prediction have been published by Van de Stok for use by seamen, and a recent publication by the International Hydrographic Bureau is based on his work. In Great Britain the movement for reform has been initiated by Commander H. D. Warburg, and it has been backed by scientific opinion. The results of his labours are extremely creditable. In the opinion of the writer the list of constants, the mode of presentation, and the instructions exceed anything yet published in this line. This serious attempt to reform the methods of prediction, and the progressive policy of the Hydrographic Department of the Admiralty, are very commendable. It is to be hoped that the methods advocated receive a favourable reception by seamen.

A. T. DODSON.

[1] "The Admiralty Tide Tables." Part 2. Fourth edition, 1927, containing Non-Harmonic Tidal Constants, Tidal Differences and Harmonic Tidal Constants for the Principal Ports, etc., of the World. Published by Order of the Lords Commissioners of the Admiralty. Pp. 508. (London: J. D. Potter, 1927.) 3s. net.

Studies of Ovarian Dynamics.

PROF. LIPSCHÜTZ, in an illuminating review of current work on this subject in *Biological Reviews*, vol. 2, No. 3, pp. 263-280, gives concrete expression to some of the main results which have emerged from the study of ovarian dynamics. In the first place, the author shows that the number of primary follicles which enters into follicular development, the degree of follicular ripening which is attained, and the further fate of the follicle, depend not upon the total number of primary follicles present, but upon general internal factors outside the ovary. This he terms the law of follicular constancy, and there is a constancy for each species.

Secondly, Prof. Lipschütz shows that the time at which endocrine activity of the ovary sets in is dependent upon the age of the internal environment and independent of the age of the ovary. Young ovary engrafted into an adult animal will begin its endocrine activity sooner than corresponds to the age of the ovary, and conversely, adult ovary engrafted into a young animal will cease endocrine activity. The ovary is only the means by which sexual puberty is realised when certain environmental factors allow follicular development and endocrine activity (the law of puberty). The influence of body growth on the ovary is next discussed, and it is shown that certain growth substances, not sex specific, which are necessary for both body growth and follicular

development, are not available for the latter so long as there is an intensive growth of organs before puberty.

Finally, the sex specific reaction to the ovarian graft is considered, with special reference to the guinea-pig. Here castrated males and castrated females behave differently when engrafted each with an ovary of the same female, the male showing rapid and uninterrupted progressive development to a state of hyper-feminisation, while in the female development is slower and interrupted, with a certain amount of regression, and it never attains the same degree of hyper-feminisation nor is there ever milk secretion. This difference is due, not to somatic differences in the sexes, but to the different behaviour of the ovarian graft, due to some unknown internal factors. The author concludes that general internal factors outside the ovary are of fundamental importance equally with the ovarian hormones, in maintaining a normal sexual cycle.

University and Educational Intelligence.

BIRMINGHAM.—The transfer of the Zoological Department from Mason College to the new buildings at Edgbaston is now completed. The new quarters, which are spacious and well lighted, include a teaching museum and excellently equipped laboratories both for research and routine teaching of all grades. A good departmental library is provided to meet the needs of research workers. Special attention is to be given to comparative invertebrate physiology, experimental embryology, and entomology (including field work).

MR. GEOFFREY EVANS has been appointed principal of the Imperial College of Tropical Agriculture at Trinidad. Mr. Evans was in the Indian Agricultural Service from 1906 until 1926. He was for a time attached to the Queensland Government in Australia as director of cotton culture, and during this period he also worked in Fiji, Papua, and New Guinea.

SOME experiments in Indian education are described in a pamphlet (Occasional Report, No. 14) recently issued by the Indian Government Bureau of Education. The Dalton plan has been tried with notable success in high schools at Shillong in Assam and at Dacca in Bengal and adapted with good results to the needs of one-teacher primary schools in Assam. Its success at Shillong is the more remarkable by reason of the multiplicity of vernacular languages used in the school and the lack of anything like adequate accommodation. After four years' trial the teachers are enthusiastically in favour of the new method and endeavour to turn even the periods devoted to class teaching into something more of the nature of conferences of teachers and pupils. Experiments at the American Presbyterian Mission training school at Moza in the Punjab have been directed toward evolving a type of education which will succeed in village schools through relating closely to the pupils' village environment all the work, including the practical farm and domestic training, but in such a way as to tend toward the bettering of present village conditions. The principle of 'learning by doing' and the 'project' method are constantly applied, and great attention is paid to cultivating a capacity for self-help. An account of the introduction of a scheme of medical inspection of school children at Simla concludes with the remark that although a feeling of dismay exists generally in India on account of the present neglected position of this work, yet the Simla Municipality congratulates itself that school medical inspection for its boys is equal to that of any town in the West.

Calendar of Discovery and Invention.

August 21, 1843.—It was during the Cork meeting of the British Association in 1843 that Joule on Aug. 21 read to "an unwilling audience of six" his paper "On the Calorific Effects of Magneto Electricity and the Mechanical Equivalent of Heat." From the experiments described he obtained the value of 838 ft.-lb. for the mechanical equivalent. In a postscript to this paper Joule said that he was satisfied "that the great agents of nature are by the Creator's fiat indestructible, and that whatever mechanical force is expended, an exact equivalent of heat is always obtained."

August 22, 1765.—In 1713 an Act of Parliament was passed offering sums of £10,000, £15,000, £20,000 to any one who could discover a method of determining the longitude at sea within 60, 40, or 30 geographical miles respectively. The reward of £20,000 was eventually won by John Harrison, whose fourth timepiece, in the form of a watch about 5 in. in diameter, during a voyage in the winter 1761–1762, enabled the position to be determined within 18 miles, and during a voyage in 1764 to be determined within 10 miles. Harrison, however, was treated with illiberality by the authorities, who improperly withheld the reward and imposed new conditions. One of the new conditions was that he should give a full explanation of the principles of his timepiece, which he accordingly did on Aug. 22, 1765, in the presence of Maskelyne and six experts appointed by the Board of Longitude. In spite of this, it was not until 1773, when he was eighty years of age, that the final balance of £8570 was paid to him.

August 22, 1850.—In the Statuary Hall of the Capitol, Washington, D.C., stands the statue of Dr. James Gorrie (1803–1855), a pioneer of artificial refrigeration, who was the first to obtain cold by causing compressed and cooled air to expand in working a piston in a cylinder. Gorrie's patent was dated Aug. 22, 1850. He died at Apalachicola, Florida, and his statue was placed in the Capitol by that State.

August 24, 1871.—Helmholtz visited Scotland in 1871, and in a letter to his wife from St. Andrews, dated Aug. 24, 1871, he referred to a dinner with Crum Brown the chemist and Sylvester the mathematician. Helmholtz in his letters also gave the amusing sketch of Tait: "Mr. Tait knows of nothing else here but golfing. I had to go out with him. My first stroke came off; after that I hit either the ground or the air. Tait is a peculiar form of savage; lives here, as he says, only for his muscles; and it was not till to-day, Sunday, when he dare not play and did not go to church either, that he could be brought to talk on rational subjects."

August 26, 1856.—While a student and assistant under Hofmann at the Royal College of Chemistry, Oxford Street, Perkin, who was then but eighteen years of age, while experimenting during the Easter vacation of 1856 with the object of producing quinine artificially, was led to oxidise aniline, obtaining as the product the colouring matter known as aniline purple or mauve. The new dye was favourably reported on by Pullars of Perth, and it was patented by Perkin on Aug. 26, 1856. The following year Perkin set up a factory at Greenford Green, with the aid of his father and brother, and from this dates the birth of the great coal-tar colour industry.

August 27, 1783.—The use of hydrogen in balloons was due to the French physicist, Charles, whose trial balloon, 3·9 metres in diameter, was released Aug. 27, 1783. E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, July 11.—The president announced the death of M. **Mittag-Leffler**, *correspondant* in the Section of Geometry.—E. **Cartan**: The Rieman forms of geometries with semi-simple fundamental group.—G. **Pfeiffer**: Systems of partial differential equations of the first order with several unknown functions possessing the integral of Hamburger.—**Soula**: The comparison of the two functions $\Sigma a_n z^n$ and $\Sigma z^n/a_n$.—Ernest **Esclangon**: Observations of the partial eclipse of the sun of June 29, 1927, made at the Strasbourg Observatory. The results of measurements of the times of first and second contacts are given. The weather conditions were very favourable.—Th. **Moreux**: Observations of the eclipse of the sun of June 29, 1927, at Bourges.—Raoul **Ferrier**: The limit of application of the theory of the vector potential.—P. **Lasareff**: The law of viscosity of H. Le Chatelier. This formula expressing the viscosity η of glass as a function of the temperature t, namely, $\log(\log \eta/\eta_0) = N - Mt$, where η_0, M, and N are constants, has been applied to the experimental data of Stott for glass, of Thorpe and Rodger for amyl alcohol, and of Deriaguine and Khananov for solutions of sugar in glycerol. The formula applies in all these cases.—Félix **Michaud**: Binary mixtures of volatile liquids. The case where the two components form a compound.—Emmanuel **Dubois**: The Volta effect. A metal becomes electronegative with respect to its initial state if it is heated (in a vacuum) to a sufficiently high temperature. The saline impurities which are normally found on the surface of a metal, and probably also in the body of the metal, may take an important part in these variations.—Nicolas **Perrakis**: The magnetic study of vanadium tetroxide and trioxide; the measurement of the atomic moment of trivalent and tetravalent vanadium. Whilst vanadium in the state of tetroxide possesses within two well determined intervals of temperature two different moments, the one of 8 and the other of 14 magnetons, in the state of trioxide it possesses a moment of 9·5 magnetons.—Edgar Pierre **Tawil**: Some observations in resonance made on piezo-electric quartz.—R. **Descamps**: The natural rotatory power, in the ultraviolet, of aqueous solutions of the neutral tartrates of sodium, potassium, and ammonium.—L. **Andrieux**: A new method of preparing boron. On electrolysing at 1100° C. a mixture of boric anhydride (2 mol.), magnesia (1 mol.), and magnesium fluoride (1 mol.) in a carbon crucible with an iron cathode, there is obtained a deposit on the cathode which consists mainly of boron. After powdering, treating with hydrochloric acid and drying in a vacuum, this deposit contains 92 per cent. of boron.—Josef **Hrdlička**: The influence of the preliminary lighting and the disagreement with the law of reciprocity in photography.—Mlle St. **Maracineanu**: the special effect of polonium, sunlight, and electricity at high voltage on lead. The results of the experiments described suggest that the formation of a new radioactive substance occurs in the lead sheet.—**Deslandres**: Remarks on the preceding communication. These results are of great interest but very complex, and their exact interpretation requires much additional research.—Albert **Portevin** and Etienne **Pretet**: Study of the velocity of solution of the ultra-light magnesium alloys. A discussion of the methods available for measuring quantitatively the rate of solution.—F. **Bourion** and E. **Rouyer**: Determination of some complex compounds by the boiling-point method.—**Pariselle**: The polarimetric and electrometric study of the alkaline aluminotartrates. A double phenomenon of mutarotation.—Charles **Prévost**: A new class of tautomeric compounds; the ionic theory of tautomerism.—Mlle Jeanne **Lévy** and P. **Weill**: The reality of the semipinacolic transposition. The study of anisylmethylethylglycol. From the experiments described it is concluded that the transformation of anisylmethylethylglycol into a ketonic product different from that furnished by the aldehydoketonic transposition of anisylmethylbutanal demonstrates the reality of the semipinacolic transposition. In the semipinacolic transposition the ethyl radical shifts more easily than the methyl radical.—Edouard **Roch**: The western extremity of the Djebilets massif (Morocco).—P. **Russo**: The presence of Archæocyathus in the Djebel Ighoud (Western Morocco).—V. **Agafonoff**: The zones of the soils of France.—J. **Dufay**: The intensity of the green line of the polar aurora in the spectrum of the nocturnal sky.—Edouard **Salles**: The fixation of the radioactivity of the air by the terrestrial electric field.—Henri **Coupin**: The carbon nutrition of *Penicillium glaucum* by means of various carbon compounds of the aromatic series. Compounds of the aromatic series are much less favourable than compounds of the fatty series for securing the carbon nutrition of *Penicillium glaucum*, and this is probably true also for other moulds.—M. **Bridel** and Ch. **Aagaard**: Is melezitose a combination of saccharose with glucose? The experiments described do not confirm the view of Kuhn and van Grundherr that melezitose is a combination of saccharose and glucose.—A. **Demolon** and G. **Barbier**: Elective ionic absorption in colloidal clay.—Mme Lucie **Rabdoin** and René **Fabre**: Comparative researches on the glutathione content of some tissues and blood in the normal pigeon, the under-fed pigeon, and the pigeon deprived of B vitamin.—C. **Arnaudi**, W. **Kopaczewski**, and M. **Rosnowski**: The physico-chemical antagonisms of micro-organisms.

CAPE TOWN.

Royal Society of South Africa, May 18.—Lancelot T. **Hogben**: A method for the study of dissociation of hæmocyanin. An elaboration of the method proposed by Pantin and Hogben (1925) for studying the dissociation of the oxyhæmocyanins is described. It is possible to plot a five-point dissociation curve within a quarter of an hour with sera of arthropods and molluscs which can be kept indefinitely in the laboratory with prescribed precautions.—Sir Thomas **Muir**: The theory of Hessians from 1883 to 1914.—S. H. **Haughton**: Note on some features of part of the Orange River valley. Dealing with the geographical features of the Orange River and its northern tributaries, the gorge-like nature of the valley and its independence of the geological structure of the country were discussed; and the unity of the Great Fish River and the lower part of the Orange was suggested.—A. J. H. **Goodwin**: Archæology of the Vaal River gravels. Ever since the discovery of diamonds in the Vaal River gravels, stone implements of a large almond-shaped type have been discovered and submitted to various museums, especially the McGregor Museum, Kimberley. The gravels are situated at intervals along the Vaal River, sometimes at a considerable distance from the river, and at various levels above the river bed. They are disjointed, and form various small groups, each of which is a time sequence in itself. The lowest gravels are the latest, and are often in actual process of formation. The highest are probably the earliest. These terraces cannot be dated with any degree of accuracy, but from the fossils discovered we must

regard the earliest (highest) as being of Lower Pleistocene age. The implements appear only in the lower terraces, and must therefore be regarded as of later date than the Lower Pleistocene, owing to the complete lack of such implements in the oldest terraces. These implements are of a type similar to those described by Péringuey as of 'Stellenbosch' type, but the technique approximates more closely to the culture described by Mr. C. van Riet Lowe, from Fauresmith, O.F.S., due possibly to the similarity of material. The Vaal River sites also show that the smaller implements, popularly called 'Bushman,' are of far later date than the large almond-shaped types.—P. R. v. d. R. **Copeman**: Studies in the growth of grapes (Part ii.): Relationship between sugar and acid in the juice. There is a very high degree of negative correlation between these two factors. The regression lines are not, however, linear, but the acid may be expressed in terms of the sugar by means of the equation $(y-a)^n = A/x - B$, where x and y are the sugar and acid respectively and a is the minimum acidity. This equation is only applicable during the period of decrease of acidity.

GENEVA.

Society of Physics and Natural History, June 16.—L. **Duparc**: Some chromite deposits of Thessaly. The author has examined several deposits now being worked in the Katarini region as well as the outcrops in the vicinity. These are basic segregations in the serpentinised peridotites.—Amé **Pictet** and Hans **Vogel**: The synthesis of maltose. This substance has been obtained by heating in a vacuum at 150° C. a mixture of α-glucose and β-glucose. At this temperature the α-glucose is transformed into glucosane; the β-glucose is not dehydrated and it forms an addition product which is maltose.—G. **Menkès**: Researches on the action of vitamins on the fungi. Experiments made on various cultures of Aspergillus show that an alcoholic extract of tomato containing vitamin principles, principally factor B, accelerates the growth of the mould and facilitates the assimilation of sugar, in agreement with results of observations made on animals.—M. **Hausmann**: The synthesis of ethyl galactoside in media with different pH. The author proves by experiments on the synthesis of ethyl-galactoside by means of emulsin, that the variations of the pH of the medium influence the ferment in its synthetic functions and that this influence is identical with that exercised on hydrolysis.—M. **Hausmann**: The molecular proportions to be observed in the cresol blue reaction (tyrosinase). In testing for the best molecular proportions for the formation of the colouring matter known as cresol blue produced by the action of the tyrosinase ferment on a mixture of glycocine and paracresol, the author shows that an equimolecular proportion of these two substances is clearly not the best, and that the optimum is attained by a mixture of four molecules of p-cresol with one molecule of glycocine.—Ch. G. **Boissonnas** and E. **Briner**: The oxidation of nitrogen by ozone. By experiments carried out at the ordinary pressures and at temperatures between 20° C. and 200° C., as well as in experiments under a pressure of 120 atmospheres, it is shown that ozone is incapable of oxidising nitrogen.

SYDNEY.

Linnean Society of New South Wales, May 25.—C. P. **Alexander**: The interpretation of the radial field of the wing in the Nematocerous Diptera, with special reference to the Tipulidæ. A new interpretation of the radial field of the wing in the Diptera.—Dudley **Moulton**: New gall-forming Thysanoptera of Australia. Four new species belonging to four different genera, one of which is new, are described.—Miss H. **Claire Weekes**: Note on reproductive phenomena in some lizards. An omphaloplacenta and an allantoplacenta occur in the scincid lizards *Lygosoma quoyi*, *Egernia whitei*, and *E. striolata*. The allantoplacentation in *L. quoyi* more closely resembles that found among the Mammalia than any hitherto recorded in a reptile, there being a partial degeneration of maternal and fœtal epithelial tissue allowing for a close proximity of maternal and fœtal bloodstreams. Corpora lutea occur in the ovaries of all the above species and in *Tiliqua scincoides*. The extra-embryonic mesoderm in all four species dips into the yolk-sac endoderm and grows round the yolk-sac embedded in its substance, and not over its surface as is usually the case.—J. **McLuckie** and A. H. K. **Petrie**: An ecological study of the flora of Mount Wilson (Part iv.). Habitat factors and plant response. The two factors of outstanding significance in controlling the distribution of the vegetation at Mount Wilson are aspect and moisture-content of the soil. The Malayan Rain-Forest flora (Ceratopetalum-Doryphora Association) is a mesophytic community which has survived in the most favourable habitats provided by the basalt residuals and the deep sandstone gorges which dissect the area.

Royal Society of New South Wales, June 1.—A. R. **Penfold** and F. R. **Morrison**: A critical examination of *Eucalyptus dives* and the occurrence of a number of varieties thereof as determined by chemical analysis of the essential oils (Part i.). Three varieties, indistinguishable from the type on morphological grounds, have been determined by chemical analysis.—J. C. **Earl**: The preparation of tetramethylethylene. A new method utilising several known reactions has been devised. The scheme of reactions is: amylene hydrate $\longrightarrow$ trimethylethylene $\longrightarrow$ trimethylethylene chlorohydrin $\longrightarrow$ dimethyl*iso*propylcarbinol $\longrightarrow$ tetramethylethylene. The yield is good, and the process can be interrupted at any stage without risk of deterioration of the intermediate products.—Sir George H. **Knibbs**: Protogenesis and ex-nuptial natality in Australia. The maximum frequency of ex-nuptial births occurred during the period 1899 to 1907; it may be subject to long-period oscillations. The frequency both of nuptial and ex-nuptial cases at the beginnings and endings of the reproductive life, show that both growth and decay are approximately but not exactly exponential. Both commence at about 12 years of age, but the relative frequency, compared with the numbers at risk, is much less for ex-nuptial cases than for nuptial. At age 16·4 the actual numbers are, however, equal. The actual phenomena of nuptial first-births, according to the ages of the mothers, can be represented by three co-ordinates, x denoting age, y denoting the duration of marriage, and z denoting the relative frequency of first-births corresponding to particular ages and durations of marriage. The protogenesic surface discloses the continuity of the phenomena for intervals of less than nine months from marriage with those for all intervals up to 27 years. Fertility varies with age and with time. For births within 9 months of marriage, it was greatest for say 1910·0 and also for 1919·0 for age 21, the numbers for 10,000 women of that age being respectively 1281 and 1248. For all first births it was for age 22 for 1910·0, 23 for 1915·5 and for 1922·5, the respective numbers per 100,000 mothers being 9401, 9363, and 8706. The averages for the year 1917·2 were 1256 and age 21 for births up to 9 months after marriage, and 910 for age 23 for all first births. These are maximum ages and

fertilities. The maximum intensity of the gonad urge would appear to be for age 21·3 years both nuptially and ex-nuptially.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 13, No. 5, May).—Joel H. **Hildebrand**: A quantitative treatment of deviations from Raoult's law. Plotting $\log N_2$ against $1/T$, where N_2 is the mole fraction of the solute, shows that many solvents give with each solute a characteristic group of curves. Dealing with binary mixtures, an extension of Raoult's law is obtained from which several physico-chemical quantities can be calculated.—Oliver R. **Wulf** and Richard C. **Tolman**: The thermal decomposition of ozone. Homogeneous decomposition can be made to proceed so as to be closely of the second order with respect to ozone; the specific rate for different samples may vary considerably but is generally, for ozonised oxygen, inversely proportional to the total pressure. This is considered to be due to the inhibiting effect of oxygen on the decomposition.—C. M. **Cleveland**: Concerning points of a continuous curve that are not accessible from each other.—O. E. **Glenn**: Recent progress of investigations by symbolical methods of the invariants of bi-ternary quantics.—C. F. **Roos**: A dynamical theory of economic equilibrium. For equilibrium in a co-operative society, a functional operator must be maximised; for a competitive society, partial maxima of several functional operators must be obtained.—Lester R. **Ford**: (1) On the foundations of the theory of discontinuous groups of linear transformations. The concept of the isometric circle of a linear transformation is applied to such groups. (2) On the formation of groups of linear transformations by combination.—Erich F. **Schmidt**: A stratigraphic study of the Gila-Salt region, Arizona. The ancient pottery falls into three groups, Gila polychrome, black-on-white, and red-on-yellow. The distribution of the sherds with depth in the excavations indicates that the Lower Salt (red-on-yellow) is older than polychrome and was probably made by the builders of Pueblo Grande. The red-on-yellow was synchronous with the black-on-white.—Charles F. **Meyer** and Aaron A. **Levin**: The infra-red absorption spectra of acetylene (C_2H_2), ethylene (C_2H_4) and ethane (C_2H_6). The range 3μ and 15μ was examined and the absorption bands are found to show definite structure. Acetylene has a band ($13{\cdot}7\mu$) showing an intense central Q-branch, an R-branch showing well-marked alternation of intensity of the lines, and a P-branch with less marked alternations.—G. W. **Fox**, O. S. **Duffendack**, and E. F. **Barker**: The spectrum of CO_2. A continuous flow method was used. A stream of pure carbon dioxide was passed slowly into the discharge tube and subjected to electron bombardment in a force-free space before reaching the filament. None of the bands generally attributed to carbon monoxide was observed. The carbon dioxide spectrum extends from 5000 Å.U. to 2800 Å.U. and consists of bands of various types.—Gilbert N. **Lewis**: The entropy of radiation. Assuming that radiation can be divided into slices of constant entropy independent of the presence of other slices, and that the chance of a particle being in a selected volume is a linear function of the number of particles already in that volume, Planck's entropy equation is obtained as a first approximation and a further approximation is indicated.—Carl **Barus**: Linear elements of the electromagnetic pinhole graphs.—Edwin H. **Hall**: Thermionic emission and the "universal constant" A. An equation for thermionic emission is derived by utilising the dual theory of conduction. In form it is similar to Richardson's equation, but the factor corresponding to A is variable.—H. **Bateman**: Lagrangian functions and Schrödinger's rule.—F. D. **Murnaghan** and K. F. **Herzfeld**: Two remarks on the wave-theory of mechanics. The degree of arbitrariness in the wave-equation and the energy-frequency relation are discussed.—K. T. **Compton** and C. C. **Van Voorhis**: Heats of condensation of positive ions and the mechanism of the mercury arc. If neutralisation of the ion occurs at or just outside the surface of the electrode, half the energy is lost by radiation and a portion by reflection. Then the heating of the cathode is given by $\phi_+ = r V_i + L - \phi_e$, where V_i is the heat of recombination of an ion and an electron, L the latent heat of condensation of the neutral gas, ϕ_e the heat of evaporation of an electron, and r is a factor less than 0·5 by an amount depending on the reflecting power of the electrode. In the mercury arc, the electrons are drawn out by the intense space charge (Langmuir) and mercury is lost from the cathode as drops consisting of numbers of atoms.—R. J. **Lang**: Series spectra of silver-like atoms. The first members of each of the four ordinary series for In III., Sn IV., and Sb V. have been identified.—J. B. **Green** and R. A. **Loring**: Term-structure and Zeeman effect of the arc spectrum of tin (preliminary report).

Official Publications Received.

BRITISH.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1926. Pp. 149+8 plates. (Bristol.)

Journal of the Chemical Society: containing Papers communicated to the Society. July. Pp. iv+iv+1401-1758. (London: Gurney and Jackson.)

Observations made at the Royal Observatory, Greenwich, in the Year 1925. Astronomy, Magnetism and Meteorology. Under the Direction of Sir Frank Dyson. Pp. 10+Axxii+A58+iv+B22+C20+Dix+D97+6+Exxvi+E106+5 plates+18. (London: H.M. Stationery Office.) 40*s*. net.

Determinations of Effective Wavelengths of Stars made at the Royal Observatory, Greenwich, in the Years 1920 to 1925, under the Direction of Sir Frank Dyson. Pp. 58. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Cape Astrographic Zones, Vol. 9. Catalogue of Rectangular Co-ordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope. Commenced under the Direction of Sir David Gill; Completed and prepared for Press under the Direction of S. S. Hough. Zone −49°. Pp. xxxvi+452. (London: H.M. Stationery Office.) 55*s*. net.

Ceylon Journal of Science. Section A: Botany. Annals of the Royal Botanic Gardens, Peradeniya. Edited by A. H. G. Alston. Vol. 10, Part 3, July 1st. Pp. 243-319. (Peradeniya: Department of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

Empire Cotton Growing Corporation. Report of the Executive Committee, to be submitted at the Meeting of the Administrative Council on July 27th, 1927. Pp. 12. (London.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1927-28. Pp. 206+26 plates. (Bradford).

Aeronautical Research Committee: Reports and Memoranda. No. 1077 (Ae. 258): Lateral Stability with special reference to Controlled Motion. By H. M. Garner. (A.2.a. Stability Calculations and Model Expts., 121.—T. 2387.) Pp. 19+5 plates. 1*s*. net. No. 1080 (Ae. 260): Note on the Reduction of Performance Tests to the Standard Atmosphere. By R. S. Capon. (D.1. Special Technical Questions, 197.—T. 2398.) Pp. 8. 4*d*. net. No. 1084 (Ae. 263): A Paradox in Fluid Motion. By Dr. H. Lamb. (A.1.a. Dynamical Similarity, etc., 64.—T. 2371.) Pp. 4. 3*d*. net. (London: H.M. Stationery Office.)

Journal of the Indian Journal of Science. Vol. 10A, Part 1: i. Some Reactions of Carone, by Kottiazath Narayana Menon and John Lionel Simonsen; ii. A Synthesis of Morindone, by Ramkanta Bhattacharya and John Lionel Simonsen; iii. Derivatives of Acenaphthpyridine, Part 1, by Srikumaran Unni Nair and John Lionel Simonsen. Pp. 13. 12 annas. Vol. 10A, Part 2: Oils and Fats from the Seeds of Indian Forest Plants. Part viii: The Oil from the Seeds of *Thevetia neriifolia* (Juss.), by Ramkanta Bhattacharya and P. Ramaswami Ayyar; Part ix: The Oil from the Seeds of *Cerbera odollam* (Gaertn.); Part x: The Oil from the Seeds of *Holarrhena antidysenterica*; Part xi: The Oil from the Seeds of *Anona squamosa* (Linn.), by Ramachandra Vishnu Ghanekar and P. Ramaswami Ayyar. Pp. 15-31. 12 annas. (Bangalore.)

Department of Commercial Intelligence and Statistics, India. Agricultural Statistics of India, 1924-25. Vol. 2: Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment in certain Indian States. Pp. vii+87. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2*s*.

Department of Agriculture, Trinidad and Tobago. Guide to the Royal Botanic Gardens, Trinidad. By R. O. Williams. Pp. iii+30+vi+12 plates. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.) 1*s*.

Nyasaland Protectorate: Geological Survey. Bulletin No. 3: The Limestone Resources of Nyasaland, with Notes on the Uses of Limestone and on the Manufacture of Lime. By Dr. F. Dixey. Pp. 43. (Zomba.) 2s. 6d.

FOREIGN.

Results of the Meteorological Observations in Tyôsen for the Lustrum, 1921-1925. Pp. vi+52. (Zinsen: Meteorological Observatory of the Government-General of Tyôsen.)

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1924. Pp. iv+150. (Zinsen.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 20. (New York.)

United States Department of Agriculture. Department Bulletin No. 1482: Experiments on the Control of the Plum Curculio, Brown Rot, and Scab, attacking the Peach in Georgia. By Oliver I. Snapp and C. H. Alden, John W. Roberts and John C. Dunegan, and J. H. Pressley. Pp. 32. Department Circular 410: United States Standards for Honey, recommended by the United States Department of Agriculture. Pp. 32. 5 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 65: Growth, Bud-Shedding and Flower Production in Egyptian Cotton. By M. A. Bailey and T. Trought. Pp. 40+33 plates. (Cairo: Government Publications Office.) 5 P.T.

Proceedings of the Imperial Academy. Vol. 3, No. 5, May. Pp. xi-xiii+247-306. (Tokyo.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 20: East-Monsoon Forecasting in Java. By Dr. H. P. Berlage, Jr. Pp. ii+42. (Weltevreden: Landsdrukkerij.)

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 10, 1926. Pp. 247+xxvi. (Rochester, N.Y.)

League of Nations. Report on the Reform of the Calendar submitted to the Advisory and Technical Committee for Communications and Transit of the League of Nations by the Special Committee of Enquiry into the Reform of the Calendar. (Publications of the League of Nations. VIII. Transit, 1926. VIII. 6.) (A.33, 1926, VIII.) Pp. 163. Advisory and Technical Committee for Communications and Transit: Special Committee of Enquiry into the Reform of the Calendar. Classification and Summary of Proposals for Calendar Reform received before July 1st, 1926. (Publications of the League of Nations. VIII. Transit, 1927. VIII. 8.) (C. 167, M. 49, 1927, VIII. Annex III. to Document A.33, 1926. VIII.) Pp. 58. (Geneva: League of Nations; London: Constable and Co., Ltd.)

Diary of Societies.

SATURDAY, AUGUST 20.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.—Annual General Meeting.

CONGRESSES.

AUGUST 22-26.

PATHOLOGICAL AND BACTERIOLOGICAL LABORATORY ASSISTANTS' ASSOCIATION (in University Pathology Department, Cambridge).

August 22.—At 10.30 A.M.—W. A. Mitchell: Cambridge (Lecture).

August 23.—At 9.30 A.M.—A. E. P. Grimmo: The Manufacture of Smallpox Vaccine as carried out in the Laboratories of the Shanghai Municipal Council.

J. J. Ritchie: Antagonism and Symbiosis of Bacteria.

Prof. G. H. F. Nuttall: The Development of Parasitology.

August 24.—At 9.30 A.M.—S. J. Denyer: Virulence Tests in the Identification of B. Diphtheræ.

A. Saunders: Diversions of an Overseas Laboratory Assistant.

J. McLean: Rare Fæcal Organisms which simulate Pathogens.

August 25.—At 9.30 A.M.—F. Leeson: The Preparation of Plague Vaccine.

S. Linfoot: Laboratory Work in a Spa Hospital.

E. Steele, J. McLean, and others: Discussion on Laboratory Economics.

E. C. Haddon: The Biuret Reaction.

S. J. Denyer: Difficulties encountered in the Differentiation of Paratyphosus A, B, and C.

H. Gooding: On Mounting Frail Museum Specimens on Wax Plates.

V. C. Norfield: Tissue Cultivation Technique.

August 26.—At 9.30 A.M.—Demonstrations of Exhibits.

EMPIRE MINING AND METALLURGICAL CONGRESS.

Montreal Meetings, August 22 *and* 23.—Sir Thomas Holland: Proposed Review of the Mineral Resources of the Empire.—G. M. Carrie and C. S. Pascoe: Magnesia Refractories for Steel Furnaces.—A. Stansfield: Smelting Titaniferous Iron Ores.—W. A. Toohey: Portland Cement in Canada.—Mining and Metallurgical Practice in Australia.—Health Safety Problems.

Toronto Meetings, August 25 *and* 26.—C. Johnson: Winning and Refining of Precious Metals from Sudbury Ores.—R. C. Stanley: Nickel, Past and Present.—A. A. Cole: The Silver Mining Industry of Canada.—J. G. Morrow: The Cascade Method of Pouring Steel.—A. Mavrogordato and H. Pirow: Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3.—G. E. Cole: The Development of Gold Mining in Canada.—W. A. Quince: Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine.—C. R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger: A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14.—C. P. Browning: Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J. Lee: The Coal Industry in Western Canada.—J. Ness: Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone: A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linsi Mine of the Kailan Mining Administration, North China.—A. E. Cameron: Impact Resistance of Steel at Low Temperatures.

Quebec Meetings, September 5 *and* 26.—J. G. Ross: Asbestos Mining and Milling.—A. W. Nash: Possible Auxiliary Sources of Liquid Fuel.—A. Job: The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas.—G. W. Sharp: The Tipping and Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 *and* 10.—F. W. Gray: Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadfield: The Metal Manganese and its Properties: also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

AUGUST 27-SEPTEMBER 1.

INTERNATIONAL CONGRESS OF ORIENTALISTS (at Oxford). In following sections: General (including Anthropology, Ethnography, Prehistoric Archæology, Comparative Mythology, and Folklore), Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo-European Languages of Asia, the Old Testament, the Language, Literature, etc., of Islam, and Oriental Art.

AUGUST 29-SEPTEMBER 3.

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPER AIR (at Leipzig).

AUGUST 31-SEPTEMBER 7.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Leeds).

Wednesday, August 31, at 8.30 P.M.—Sir Arthur Keith: Darwin's Theory of Man's Descent as it stands To-day (Presidential Address).

Thursday, September 1, at 10 A.M.—Addresses by Sectional Presidents: B (Chemistry).—Dr. N. V. Sidgwick: Co-ordination Compounds.—D (Zoology).—Dr. G. P. Bidder: The Ancient History of Sponges and Animals.—E (Geography).—Dr. R. N. Rudmose Brown: Problems of Polar Geography.—G (Engineering).—Sir J. B. Henderson: Invention.—K (Botany).—Prof. F. E. Fritsch: Some Aspects of the Present-day Investigation of Protophyta.

At 11 A.M.—F (Economics).—Prof. D. H. Macgregor: Rationalisation of Industry.—M (Agriculture).—C. G. T. Morison: Agriculture and National Education.

At 2 P.M.—Conference of Delegates of Corresponding Societies.

At 2.30 P.M.—Discussion (Sections J. L): The Psychology of Special Scholastic Disabilities.

Friday, September 2, at 10 A.M.—Addresses by Sectional Presidents: A (Mathematical and Physical Sciences).—Prof. E. T. Whittaker: The Outstanding Problems of Relativity.—H (Anthropology).—Prof. F. G. Parsons: The Englishman of the Future.—I (Physiology).—Dr. C. G. Douglas: The Development of Human Physiology.—Discussion (Section G): Coal.—Discussion (Sections K. M): The Control of Plant Diseases.

At 11.30 A.M.—Address by the President of Section L (Education), Her Grace The Duchess of Atholl: The Broadening of the Outlook in Education.

At 8.30 P.M.—Evening Discourse by Prof. R. A. Millikan: Cosmic Rays.

Monday, September 5, at 10 A.M.—Addresses by Sectional Presidents: C (Geology).—Dr. H. H. Thomas: Centres of Tertiary Volcanic Activity in Britain.—J (Psychology).—Dr. W. Brown: Mental Unity and Mental Dissociation.—Discussion (Sections A. B): The Structure and Formation of Colloidal Particles.—Discussion (Section G): Lubrication.

At 8.30 P.M.—Evening Discourse by Dr. F. A. E. Crew: The Germplasm and its Architecture.

Tuesday, September 6, at 10 A.M.—Discussion (Sections C. K, and Cosmical Physics Department of Section A): Climates of the Past.—Discussion (Sections F. J): Innate Characteristics and Social Differences.

At 2 P.M.—Conference of Delegates of Corresponding Societies.

Wednesday, September 7, at 12 NOON.—Concluding General Meeting.

SEPTEMBER 1-4.

SCHWEIZERISCHE NATURFORSCHENDE GESELLSCHAFT (at Basel) (in 14 Sections).—Presidential Address by Dr. F. Sarasin.—Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

SEPTEMBER 3-10.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (at Prague)

SEPTEMBER 4-9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

SEPTEMBER 11-17.

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

SEPTEMBER 11-18.

INTERNATIONAL CONGRESS OF GENETICS (at Berlin). In three sections: General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

SEPTEMBER 18-OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome). In four sections: Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.