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The Grant of Invalid Patents.

BRITISH justice is a pearl of great price. More specifically it may be stated that in the case of patent actions in the High Court its price ranges from £600 to £1000 a day, and that such actions may last for a number of weeks. Dr. Levinstein has performed a public service in giving prominence, in his recent address to the Bristol section of the Society of Chemical Industry, to this costliness, which is a fundamental defect in the British patent system. Owing to the high cost of patent litigation, to which he referred in language warmed by bitter experience, the consideration for which patent rights may be enjoyed is nowadays not so much the introduction of a new invention as the possession of exceptional wealth. A genuine inventor cannot, unless he be supported by very large financial resources, prevent his invention from being freely copied: for his only remedy lies in an action for infringement, and this might cost him a fortune, even if he succeeded in winning it. On the other hand, a bogus invention, embodied in an invalid patent, can be used to hamper manufacturers or to extract royalties in a manner which is scarcely distinguishable from blackmail. "Thousands of unjustified monopolies are being legally granted," says Dr. Levinstein, "and sometimes the holders threaten the very existence of those invading their privilege."

Some time ago it was estimated that there existed in Great Britain about 105,000 live patents, of which 33 had been tested in the Courts and found valid, while an equal number of coeval patents had been found invalid. Of the remainder, a large proportion must certainly have been invalid. "Is it not an abominable restraint of trade", asks Dr. Levinstein, "that we are fettered annually by the State with this enormous number of monopolies which, if exercised, would be improperly exercised? Lying unexercised, each one is a latent danger to the merchant adventurer, an unnecessary peril of the sea of discovery."

Various remedies have been proposed for this unfortunate state of things. The British Science Guild, in a report which has formed the basis of all recent discussions of patent law reform, made a number of proposals which would mitigate the evil to a certain limited extent. It suggested, for example, that the law with regard to unjustifiable threats should be strengthened, and that the Comptroller should be empowered to try infringement actions by consent of the parties. But the latter provision could not prevent the abuse of

wealth to which reference has been made. It is true that actions before the Comptroller are cheap: counsel accept lower fees, the procedure is more expeditious, less expert evidence is needed for explaining technicalities to the tribunal. A High Court action probably costs hundreds of times as much as an opposition before the Comptroller, and the latter form of proceedings is coming to be used as a cheap method of obtaining an official opinion on validity. But the trial of an infringement action before the Comptroller would not be either compulsory or free from the right to appeal, so that either of the parties could insist on going to the High Court if he wished to ruin his opponent.

The remaining remedies recommended by the British Science Guild aim at reducing the number of invalid patents granted annually by the Patent Office: it is suggested that that office should be empowered to enforce a stricter standard, at least in respect of novelty, before granting a patent. Such a provision would, to some extent, diminish the abuses which are founded on the high cost of patent litigation; but that result could be completed only if, after an adequate official scrutiny, the sealing of a patent were deemed to confer validity upon it as regards some specified issues. Alternatively, validation in respect of these issues might be conferred after a lapse of some years, as in certain foreign countries. Dr. Levinstein makes the converse proposal that the grant of a patent should confer the right to work it. This would necessitate an official search among the claims of all relevant live patents, acknowledgment of master patents, and recognition of third party rights when grants have been made in error.

From the legal profession such proposals could only meet with scandalised disapprobation. To deprive an Englishman (or a foreigner trading with Britain) of his inalienable right to embark upon ruinous litigation, or to inflict ruinous litigation on his neighbours, seems to be subversive of the natural rights of man. The justice dispensed by the High Court and the Lords of Appeal seems to be something which every citizen has a theoretical right to invoke, even if the recognition of that right tends to promote blackmail. Unfortunately, we have to choose between an ideal justice, accessible only to millionaires, and some more rough-and-ready form of that commodity, less infallible but more serviceable to the ordinary conduct of industry. Let us therefore examine some of the issues which have to be considered by the High Court when it determines the validity of a patent, and ask what would be the consequence of allowing them to be settled administratively, after an adequate scrutiny, at the time when a patent is sealed or after the lapse of a given interval.

One of these issues is 'novelty' as determined by documentary evidence; prior user, which arises less frequently in modern litigation, would need to be discussed separately. Every patent agent and every examiner in the Patent Office construes hundreds of specifications in the course of a year. The number of documents relating to his special industry which he construes, and his familiarity with the technical details of that industry, far exceed the equipment in these respects of a High Court judge, who may never have turned his attention to the subject until it is explained to him by expert witnesses. The issue is one which requires technical understanding rather than profound legal knowledge. Provided, therefore, that the novelty of the inventions were first investigated as fully as might be practicable, more good than harm would be done if the sealing of a patent were deemed to confer, immediately or after an interval, immunity from attack on the issue of documentary anticipation. Mistakes would presumably be made by the Patent Office from time to time: but the evils arising from such mistakes would be far less serious than the evil arising from the uncertainty which prevails as to the validity of patents.

We come to the issue of 'subject-matter'. The *quale* of subject-matter is already handled by the Patent Office, which may grant patents only for inventions having the nature of a manufacture. *Quantum* of subject-matter, on the other hand, is an issue reserved entirely for the Courts: in order that a patent may be valid, the invention which it protects must differ from previous inventions, and from previous industrial practice, to such an extent that inventive ingenuity was necessary in the devising of it. Normally this issue is identical with that of novelty: only in border-line cases, where the inventive step is very small, does it become difficult to determine whether the required degree of inventive ingenuity is present or not.

The matter has been rendered mysterious by a legal fiction to the effect that inventive ingenuity is something which must be either present or absent: that it can be ascertained qualitatively and not quantitatively. As a matter of fact there are infinite gradations of ingenuity: a sparrow exercises a scintilla of ingenuity when it fits a nest into a hole of new and unfamiliar shape. Since the quantitative standard of ingenuity necessary for a valid patent is thought of as qualitative, each judge and each expert witness refers unconsciously

to his own arbitrary and independent standard. The problem is stated by asking whether a skilled workman, possessed of the knowledge which was common at the date of a given invention, could have devised the latter without exercising ingenuity. The conundrum to be solved by the learned Court is almost as difficult as that scholastic one, *utrum chimæra, bombinans in vacuo, comedere possit secundas intentiones?* The Court has to ascertain what might have been done a long time ago by a fictitious workman, in circumstances which never occurred, with the aid of an abstraction called 'common knowledge' the limits of which nobody can any longer remember, and subject to an undefined quantitative restriction which is erroneously apprehended as qualitative.

As might be expected, the judicial decisions in these matters are uncertain and conflicting. In Bonnard *v.* L.G.O.C., for example, the three judges of the Appeal Court were just as unanimous in attributing ingenuity to the invention as the five Law Lords were in denying it. Such issues could be settled more inexpensively by the tossing of a coin; and as they arise when the invention is of small extent and therefore of small merit, no great injustice could be done if they were settled adversely before the sealing of a patent. Administrative settlement of the issue would be particularly suitable if the present standards of 'subject-matter' were to be raised, and if inventions which did not reach the new standard could be made the subject of short-term patents. Mistakes would be made, inevitably: some deserving inventors would have to content themselves with short-term patents having the disadvantage of very narrow claims. But the injustice done in this way would be negligible in comparison with that which arises from the issue of floods of paper patents the validity of which is uncertain. "I am convinced", says Dr. Levinstein, "that the time to determine the state of common knowledge is before the grant of a patent, not years later: the place the Patent Office, not the Law Courts." Moreover, if mistakes are to be made, let them be made at an early stage, before a man has risked his capital on a perilous venture.

Another issue frequently fought out in Court is that technically known as 'utility': the Court has to decide whether the invention, in so far as it is described in the specification, is practicable.

In the case of mechanical and electrical inventions it is very often possible to determine, without experimental trial, whether these inventions are in principle practicable or not: but this is not always possible, and in the case of chemical inventions it is rarely possible. It was suggested, however, by the late Dr. Ehrhardt that upon an inventor's furnishing the Patent Office with satisfactory evidence of the sufficiency of his description and the practicability of his invention, his patent should be relieved from the risk of subsequent invalidation on those issues. The proposal is by no means free from objection, but even so, it is possible that the evils arising from an attempt to settle 'utility' at an early stage might be less than the evils which actually arise from uncertainty as to the validity of the 20,000 patents which are so light-heartedly granted every year by the Crown.

The above proposals will seem to members of the legal profession to merit nothing but contempt. But it must be remembered that—apart from the question how far technical inventions can be really understood by a non-technical court—the judicial system is only valuable in so far as it is available for use. Its high cost prevents it from being available to any but the very wealthiest litigants, and makes it possible for them to defeat the ends of justice. What is needed is some more rough-and-ready method of weighing the validity of patents, some method which should be cheap enough to be generally useful even though it be not infallibly just. A miscarriage of justice early in the life of a patent may be of minor consequence, whereas at a later stage it may involve the loss of enormous capital outlay. If the issues of documentary anticipation and subject-matter, and possibly also utility, could be summarily settled, after an adequate investigation, at an early stage in the life of a patent, the advantage gained by the change would outweigh the disadvantage of occasional miscarriages of justice. A long step would have been taken in the direction of restoring the patent system to its legitimate function in the national economy of Britain.

Chemistry for Students and Others.

Everyday Chemistry. By Prof. J. R. Partington. Pp. viii + 668 + xiii. (London: Macmillan and Co., Ltd., 1929.) Pt. 1, 3*s.*; Pt. 2, 3*s.*; Pt. 3, 2*s.* 6*d.* Complete, 7*s.* 6*d.*

AMONG the easiest tasks to conceive, and yet one of the hardest adequately to perform, is the production of an introductory text-book of chemistry such as shall faithfully expound the unchanging, but always fashionably dressed, principles of the science, shall include what is necessary of formal instruction concerning material facts and observations, and at the same time shall have

about it an air of freshness and vitality, a reflection of the author's own interests and personality. The text-book has perforce to be measurable in terms of the standard of instruction demanded by public examinations, and in orienting himself to this horizon any author is bound to preserve a substantial measure of conventionality in his treatment. If, as is here the case, the author looks beyond classroom walls and desires to include in his audience, without segregating them in the gallery, perfectly ordinary and knowledgeable but less purely scholastic people, his information is most easily assimilable if it is correlated with common affairs, and his illustrations most effective if they are largely borrowed from everyday human experience.

Prof. Partington has steadfastly held in view both these aims, and in his able and experienced hands the substance of the book has been collected and welded together most skilfully, most pleasantly, and most usefully, resulting in a real text-book of dimensions and cost suitable to college or arm-chair use. He has striven to introduce people to chemistry as it appears to-day rather than to popularise chemistry for the people as they appear to him ; he does not flutter abstractedly from one alluring subject to another, but sets things down decently, attractively, and in order, the result being a happy combination of the old and the new, of the formal and the informal, of philosophy and technology. The index failed at a random test; the text is worth one which, for example, includes 'iodine', 'food', and 'explosives' (524), as well as 'explosion' (452), and does not suggest that 'gas mantle' (43) and 'Welsbach mantle' (431) are distinct entries. Why, incidentally, need 'sulphuretted hydrogen' be perpetuated when the term, like cotton hose and the last-but-one atomic theory, is obviously out-of-date ?

In view of the increasingly widespread conviction that the burning of raw coal in open grates is both wasteful and injurious, owing to the pollution of the atmosphere which, especially in densely populated areas, the practice occasions, and with public determination to preserve, so far as possible, the amenities of the districts adjacent to the sites of great power stations, the paragraph on smoke abatement will be read with interest and, let us hope, resolution. By the more extensive use of gas and electricity, and by employing low-temperature coke in open grates, every reader can, without sacrifice of comfort, contribute to the solution of one of our national problems—the economic utilisation of coal—and at the same time to the advantage of the health of the community. Whilst industrial smoke is more amenable to abatement than domestic, the same considerations require that the appropriate treatment should be as rigorous and effective as possible. In London, domestic fires are estimated to be responsible for about seventy per cent of the atmospheric soot (the particles of which may contain from four to eight per cent of free sulphuric acid), whilst in industrial towns the figure is probably about thirty per cent. In the section on carbon monoxide, the results of determinations of the proportion of this poisonous gas (arising from the exhaust of automobiles) in the streets of Paris and in tunnels in the United States of America are quoted. Estimates of the carbon monoxide produced by small cars and large lorries are 41 and 184 cubic feet per hour, respectively, referred to a speed of 15 miles per hour ; had other figures been available, perhaps realism would have been better served by increasing the reference speed.

The author is not very romantic where the "romances of chemical industry" are concerned, for he declares, and no doubt with truth, that they are often fictitious, the 'discoveries' arising from forgotten patent specifications, or from publications in pure science. "Big business", he says, "usually arises from a little exhibition of genius in another place, and very often the scientific investigator who has made possible great and lucrative industrial undertakings has died in poverty." It may be added that, even if he has undertaken the expense of acquiring patent monopoly rights in Great Britain, the circumstance may be of little avail to the inventor himself, such are the opportunities under the existing law for financial might to dominate scientific claims. It is not without significance that two such influential bodies as the British Science Guild and the Association of British Chemical Manufacturers have taken up the matter with the view of securing a more equitable distribution of the rewards of service and industry. In fact, Dr. H. Levinstein, in his recent address before the Bristol section of the Society of Chemical Industry, declared that the time is approaching when the curtailment of patent monopolies will again become indispensable to the nation as it was three hnndred years ago, and that to remove the mass of bogus, bluff, blocking paper patents, valueless, but with a menace grinning through the paper mask, and to grant patents only after examination for real novelty and subject matter, would be of immense benefit to large and small industrial concerns as well as to the poor inventor.

The book under review is divided into three separate sections, namely: (1) Chemical history and theory, (2) some non-metallic elements and their important compounds, and (3) organic chemistry and metals. The inclusion of chapters on organic compounds, food, nutrition, and biochemistry, with paragraphs on food-values, vitamins, enzymes, immunology, explosives, essential oils, dyes, rubber, etc., is in harmony with the general conception of the book, as are references to X-ray spectra and the quantum theory. There is, however, no freakishness about the treatment, and the author will probably hit both birds at which he is aiming a single stone. One cannot, in conclusion, resist the temptation of asking the author why he chooses to write 'Bagdad' and 'ar-Rashid' instead of 'Baghdad' and 'al-Rashid', and whether he would resent being addressed by a follower of the 'prophet' Mohammed as 'Professor' Partington.

A. A. E.

The Vegetation of New Zealand.

(1) *Die Vegetation der Erde: Sammlung pflanzengeographischer Monographien.* Herausgegeben von Prof. A. Engler und Prof. O. Drude. Band 14: *The Vegetation of New Zealand.* By Dr. L. Cockayne. Second edition, almost entirely rewritten, thoroughly revised and enlarged. Pp. xxvi + 456 + 87 plates + 3 maps. (Leipzig: Wilhelm Engelmann, 1928.) 42 gold marks.

(2) *The Trees of New Zealand.* By Dr. L. Cockayne and E. Phillips Turner. Pp. 171. (Wellington, N.Z.: W. A. G. Skinner, 1928.) 4*s*.

(3) *New Zealand Trees and Shrubs: and how to Identify them.* By Dr. H. H. Allan. Pp. x + 188 + 31 plates. (Auckland, Christchurch, Melbourne and London: Whitcombe and Tombs, Ltd., n.d.). 6*s*. 6*d*.

THERE is perhaps no country in which the study of flora and vegetation has made greater progress in recent years than in New Zealand. This is not due to the larger number of workers engaged, nor is it because of a general increase in interest in the subject there, but rather to a marked re-orientation of viewpoint on the part of a small body of earnest investigators and the consequent opening up of new conceptions of the relationships of both species and communities. This is the result of two main factors: first, the application of the principle of succession to a study of the vegetation; and secondly, the recent visit of Dr. Lotsy to New Zealand. The three books before us reflect to different degrees this pronounced change in botanical outlook.

Botany in New Zealand, in spite of the few workers engaged in it, benefits greatly from several of its leading exponents being both ecologists and taxonomists. Investigators studying principally either the vegetation or flora of any part of the country have always the other division of the subject well in view. The advantages of such an outlook are shown in the great progress to which attention is directed above.

(1) The successional viewpoint in ecology did not find universal application at the time when the first edition of Dr. Cockayne's "Vegetation of New Zealand" was written (1913), but nevertheless is much in evidence in that book. In the second edition, however, it is the guiding principle throughout, and consequently the treatment becomes more connected. Naturally, an appearance of stability cannot be avoided everywhere; not enough is known of the development of the vegetation in many areas to deal with it entirely in a successional manner. It is in the descriptions of the forests that the greatest progress is evident, and here a really fundamental system of classification is being evolved. Much yet remains to be done, but the relationships between the sub-tropical and sub-antarctic rain forests and between the various divisions of the former are dealt with thoroughly. The importance, both ecologically and commercially, of the successional changes now in progress is obvious.

Before dealing with the "Vegetation of New Zealand" further, it is necessary to revert to the second factor mentioned above, namely, Dr. Lotsy's visit. Previous to this, the taxonomic traditions founded by J. D. Hooker and carried on faithfully by Kirk, Petrie, and particularly Cheeseman, had dominated New Zealand floristic botany. Dr. Cockayne had already in 1913 opened up several new lines of thought, but the value of these had been established only as the result of a continuous struggle against old viewpoints. The entry of Dr. Lotsy with his genetical outlook and precise specific concepts awakened into activity the dormant ideas of Dr. Cockayne and his co-workers, and suggested new explanations for many little understood and neglected observations. Some of Dr. Lotsy's concepts have been adopted wholeheartedly by New Zealand botanists, and have been employed in the discovery and elucidation of many peculiar features of the flora. Not the least important of these are the huge swarms of natural hybrids which have been detected throughout the

Dominion. The marshalling and classification of these, and the determination of their importance ecologically, is occupying the attention of several workers. When it is realised that two hundred and ninety different hybrid groups, the nature of most of which is based on substantial evidence, had been detected up to 1928, it will be seen that their presence is of considerable significance.

The study of epharmonic variation has also made great strides in New Zealand recently, and occupies a considerably larger proportion of the second edition of Cockayne's book than in the first. Bearing in mind Turesson's stimulating work on ecotypes, a great future can be predicted for studies along these lines in New Zealand.

An interesting feature of the book is the distinction from one another of what Cockayne terms *modified*, *indigenous-induced*, *exotic-induced*, and *artificial* communities. These terms are of definite value in a country in which aliens have become so important over large areas. Nevertheless, it is a striking fact that communities consisting entirely of native species, but never occurring in primeval New Zealand, have sprung up as a result of the indirect influence of man.

Dr. Cockayne's book can be strongly recommended to all interested in ecology or plant geography. It is full of original suggestions and novel conceptions and cannot fail to stimulate the reader. The format is an improvement on that of the earlier edition, the numerous subdivisions having been reduced considerably, while the elimination of the rather unsatisfactory text photographs has allowed of the inclusion of more plates at the end. The addition of another map enables the localities mentioned in the text to be inserted, and the boundaries of the botanical districts to be more accurately indicated.

(2) and (3) The other two books cited above may be looked upon primarily as adjuncts to the study of the vegetation, although they can be used separately. Both are designed as a means of identifying easily the woody plants occurring in the Dominion. Cockayne and Phillips Turner's "Trees of New Zealand" gives excellent photographs of all the important forest trees, with short descriptions and notes on distribution. There is also a brief account of the forests themselves and of the commercial timbers.

Dr. Allan's "New Zealand Trees and Shrubs" is a more remarkable work, since he succeeds in providing a means of identifying any woody plant without having resource in the first place to any but vegetative characters. The advantage of this to the working ecologist, who obviously has to deal in most communities with a majority of plants not in flower at any given time, is evident, and Dr. Allan deserves the thanks of all New Zealand students of vegetation for his carefully designed and thorough piece of work. The book is arranged on the dichotomous key system, there being a brief description of each species for confirmatory purposes. A number of useful photographs and text figures are included, among them being some illuminating hybrid series. A key to the genera, based on floral characters, is given at the end, but might have been more distinctly indicated by a special heading. Here, as in the "Vegetation of New Zealand", the importance of the hybrids, juvenile forms, and epharmones is stressed, while valuable hints are given to students.

Collectively, the three books constitute a trio which no student of the New Zealand flora and vegetation should be without, and indeed botanists in other countries may obtain useful suggestions for their own investigations from all three.

V. S. S.

British Rainfall and Weather Reports.

(1) *Meteorological Office: Air Ministry. British Rainfall, 1928: The Sixty-eighth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1928 as recorded by over 5000 Observers in Great Britain and Ireland.* Issued by the Authority of the Meteorological Committee. (M.O. 315.) Pp. xv+285. (London: H.M. Stationery Office, 1929.) 15*s*. net.

(2) *Meteorological Office: Air Ministry. The Weekly Weather Report for the period Feb. 26, 1928, to Mar. 2, 1929.* Vol. XLV. New Series. Issued by the authority of the Meteorological Committee. (M.O. 301.) Pp. 78. (London: H.M. Stationery Office, 1929.) 15*s*. net.

(1) THE sixty-eighth annual volume of the British Rainfall Organization summarises the records for 1928 from more than 5000 rain-gauges, the general method of treatment of this material being similar to that followed in the volume for 1927. It is satisfactory to note that there is an increase of 2 per cent in the number of records available for 1928 as compared with 1927, just as the number for 1927 exceeds that for 1926 by 2 per cent. Unfortunately, the greatest improvement in representation is for the counties of Surrey and Devon, both of which are already well represented, and not for any of those Scottish

and Irish counties where rainfall observers are very thinly distributed.

We learn from the summary of the year's rainfall at the beginning of this volume, that 1928 was the seventh year with a general rainfall equal to or greater than the 1881–1915 average, a run of wet years which, unless very exceptional weather is experienced during the rest of this year, will be ended by an exceptionally dry year, just as it was preceded by one (1921). A small coloured map shows very clearly the relation of this year's rainfall in different districts to the average. In general, the most elevated districts contributed most to the wet character of the year, while in England and Scotland considerable areas lying to the eastward of high ground showed a deficiency. This result was doubtless due to the fact that an unusually large proportion of the notably heavy falls was associated with cyclonic rains, which are very much assisted by the ascent of moist winds over hills and mountains. Regions with an excess of 50 per cent or more were to be found in south-west Scotland and north-west England; in Ireland no very obvious connexion between the excess of rainfall and the elevation of the land was apparent, the whole country showing a moderate excess.

Among the special articles may be noted a further valuable contribution by Mr. F. Hudleston on the effects of various kinds of wind-break upon the records of rain-gauges in exposed situations, and an article by Dr. J. Glasspoole on the rainfall of Norfolk.

(2) The Meteorological Office for fifty years published a weekly summary of meteorological observations made at a number of stations distributed throughout the British Isles, but by the autumn of 1926 the Meteorological Committee had under consideration the revision of the form of the report and the substitution for it of an annual publication in which the unit of time is still the week. The last issue of the old series covered the week ending on Feb. 25, 1928, and the first volume of the new series, which has recently been received, deals with the period Feb. 26, 1928–Mar. 2, 1929.

The old weekly report appeared so soon after the occurrence of the weather which it summarised that the latter was still more or less clearly within the memory of the reader; with the new report this will seldom be the case. In making such a change the Meteorological Committee has clearly taken the view that the weather reports issued by the B.B.C., together with the daily issues of the Meteorological Office, are sufficient to meet the needs of those who take an interest in the current weather as so much 'news', and that for the majority of statisticians, to whom the weekly averages of past years are often of equal importance with those of the current year, the most important matter is that of presenting the statistical material in the most convenient possible form. In that respect the new issue is immensely superior to the old.

There are five stations to each of the eleven districts into which the mainland of Great Britain and Ireland is divided, and for each station there is a single table, occupying a single page, which summarises the temperature, rainfall, and sunshine for each week of the year at that station. These tables enable the general character of a year in any part of the country to be determined almost at a glance. A still broader survey of the year's weather is given by four pages summarising the same information for the different districts, in the form of departures from the 'normal' for the district. In this connexion an improvement has been introduced in the technical method by which a normal is calculated, whereby the cessation of the record from a particular station, and its substitution by another of different climatic character, does not make any sensible break in the continuity of the 'district values' of temperature, rainfall, and sunshine.

On the whole, the new form of the "Weekly Weather Report" should be much better suited than the old to the needs of those research workers who wish to determine the effect of the weather upon such variables as, for example, crop-yield, the incidence of particular diseases, or the death-rate.

Archæology of Malta.

Excavations in Malta. By M. A. Murray. Part 1. With a Chapter by G. Caton-Thompson. Pp. iii +49+21 plates. Part 2. With a Chapter by G. Caton-Thompson. Pp. iii+43+33 plates. Part 3. With a Chapter by C. Ainsworth Mitchell and Thomas J. Ward. Pp. iv+38+35 plates. (London: Bernard Quaritch, Ltd., 1923–25–29.) 3 Parts, 15*s*. net.

THE vast megalithic buildings with their pillars and sculptures scattered in such profusion on the barren little island of Malta present a most fascinating problem for the archæologist. Miss M. A. Murray is to be congratulated on discovering and scientifically exploring and describing yet another of the puzzling structures during three years of most

careful and accurate excavation. Borg en Nadur, as her site is named, proves to represent a typologically early form of those 'temples' already known at Hagiar Kim, Hal Tarxien, and elsewhere in the island. It consists of two pairs of apses linked by a short passage and leading to a semicircular sanctuary, the whole opening on to a large enclosed court.

The pottery that constituted the bulk of the finds is divisible between the two classes termed by Prof. Zammit 'neolithic' and 'bronze age' respectively, but no stratigraphical separation, such as was observed at Hal Tarxien, was traceable here. In addition to her own sherds, reproduced most faithfully both as photographs and line drawings, Miss Murray collects and publishes an illustrative series of the 'bronze age' wares from other sites. When thus viewed as a whole, it is easy to see how closely this group of wares is allied by form and ornament to a class of pottery distinctive of the latest bronze age in Italy and Sicily. This phase of Maltese culture being thus correlated with the sub-Mycenean epoch in the Ægean, Sir Arthur Evans's arguments for a Middle Minoan date as the upper limit of the preceding 'neolithic' phase are materially strengthened.

In addition to broken vases, Miss Murray found a number of anchor-shaped objects of clay to which only Bahria offers parallels in the island. She points out that both sites are situated where votive offerings by mariners might be expected, but if the clay objects are really such votive imitations of anchors, they will be the earliest evidence of the use of that device in the Mediterranean.

While Miss Murray was working at Borg en Nadur, Miss Caton-Thompson was conducting scientific excavations in the cave of Ghar Dalam. As is well known, this cave contains a deposit of the bones of extinct pachyderms; and the discovery in it of a human tooth with the roots fused in a manner generally peculiar to men of the Neanderthal species led to the theory of a Mousterian occupation at the time when a land-bridge still connected Europe and Africa. The breccia of hippopotamus bones has even been interpreted as a palæolithic kitchen-midden. The most minute investigations, however, failed to produce a single implement attributable to palæolithic times, though 'bronze age' and 'neolithic' remains were abundant in the upper layers. Hence the pretty theories so vividly illustrated in a certain popular magazine a few years ago have to be abandoned; for Miss Caton-Thompson shows that the negative evidence is really conclusive. V. G. C.

Our Bookshelf.

Contributions to the Principles of Morphology. By William Bernard Crow. (Thesis approved for the Degree of Doctor of Science in the University of London.) Pp. viii + 94. London: Kegan Paul and Co., Ltd., 1929.) 5*s*. net.

THIS small volume focuses attention upon the principles underlying the branch of science which is the most neglected of all at the present time, anatomy. It is true that professors of anatomy are attached to the medical schools of Great Britain and other countries; but most of their work is concerned with matters which bear a similar relation to anatomy that a knowledge of the sites and situations of the bottles on the shelves of a chemical laboratory bears to chemistry. Morphology, as Dr. Crow rightly observes, has few practical applications except in medicine and psychology. These are not dealt with in his book. Therein is presented "the analysis of the principles of a pure science".

Although the practical applications of morphology are few, those which do exist are of such importance that they have obscured the science itself, and its principles too often are left to the whim of the individual for enunciation. Dr. Crow fears that his treatment, avoiding as it does the enormously detailed field of applications, is arid. It is, just as a statement of the bare principles of dynamics unsupported by instances and applications would be arid. But it is of great interest, nevertheless, because it affords a clear presentation of the real difference between physico-chemical materialism, which has no place for form and relationship in its concept of Nature, and morphology, for which this form, organisation, or arrangement, constitutes an individual. Such forms may be compared and measured; but resemblances are established rather than identities and equalities. Nevertheless, homology leads to seriation, and classification to theories of affinity. Morphology lives in its instances, not only in its principles, and theories of affinity need not be its final aim. Modern physics should suffice to deny the facile claim that a structural approach to biological laws is unfruitful.

The Savage as he really Is. By J. H. Driberg. (Routledge Introductions to Modern Knowledge, No. 3.) Pp. ii + 78. (London: George Routledge and Sons, Ltd., 1929.) 6*d*. net.

THE small size and cheap price of Mr. Driberg's booklet are in inverse ratio to its worth. He does not deal with the character of the savage, but merely with his capacity to think, and comes to the conclusion that they think as we do, argue, and make deductions from ascertained premises. That these deductions are often false is immaterial; they prove to be rational even when their customs appear most irrational.

Mr. Driberg bases his conclusions on a brief survey of the environment, significance of the clan, magic, medicine, and language of various African peoples, of most of whom he has intimate

personal knowledge. He indicates that there are variations in mental ability in savage communities, but he has not tried to describe the intellectual type of mind; but it is probably true to say that the savage is more disposed to the concrete than we are, though this does not exclude abstract thought and speculation. "Does it matter to us, however, how the savage thinks or behaves? . . . Only by a true appreciation of primitive ideas, only when we know how they think and why they behave as they do, can we govern them to their best advantage and our own. . . . The savage as he really is is not an academic problem, but a very concrete and urgent reality." Everyone who has any dealings with Africans, or indeed with any other primitive peoples, should buy this suggestive and practical little book. A. C. H.

Logarithmetica Britannica: being a Standard Table of Logarithms to Twenty Decimal Places. By Dr. Alexander John Thompson. Part 4: *Numbers 40,000 to 50,000.* (Tracts for Computers, No. 16.) Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the "Arithmetica Logarithmica, 1624". Pp. vi + 100. (Cambridge: At the University Press, 1929.) 15*s.* net.

PART IV. of this monumental work, the third to be published, gives the logarithms of numbers between 40,000 and 50,000. These were obtained by adding the logarithm of 0·5 to the logarithms of all the even numbers between 80,000 and 100,000 which have already appeared in Parts VIII. and IX. The present part contains an analysis of the errors for the numbers between 90,000 and 100,000 in Briggs' "Arithmetica Logarithmica" published in 1624. It is interesting to note that nearly all the errors are in the last places of the logarithms. An inspection of the analysis shows that the first group of six figures in Briggs's 15-place logarithms contains errors in 9 instances, the second group of five figures in 3 instances, the remaining errors being in the last group of four figures.

The printing and arrangement continue to deserve the highest praise. L. M. M.-T.

Taxation in the Modern State. By Prof. Alzada Comstock. (Longmans' Economic Series.) Pp. viii + 240. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THERE is probably no subject more appealing to men than one which affects their pockets; the eternal ego is the centre of attraction, and consequently Dr. Comstock's book will create a responsive echo. In most countries taxation is now a very different matter from the levies made by way of Customs and Excise from early times down to a period not really remote, but seemingly far distant on account of the world upheaval. This has entailed a complicated and scientific readjustment of burdens, variously met by various nations. Adam Smith formulated four rules of taxation: Ability to pay, certainty of incidence, convenience in form, and economy in levy. The burden upon the public is heavy (nowhere so heavy as in Great Britain); Germany has issued from the fiscal turmoil in better condition than the other countries, but this was due to the confiscation of capital during lifetime, whereas elsewhere (particularly in England) such confiscation is reserved until death supervenes, and hence income suffers. Passing over Adolph Wagner's socio-political theory, attention may be directed to Prof. Pigou's view that 'ability to pay' has been to-day converted into 'sacrifice', though without 'equality of sacrifice'; progressive income taxation, however, seems to connote the idea of parity. P. L. M.

Auguste Comte, Thinker and Lover. By Jane M. Style. Pp. v + 206 + 1 plate. (London: Kegan Paul and Co., Ltd., 1928.) 5*s.* net.

POSITIVISM has been defined as the "system of philosophy which limits itself to the study of phenomena and the laws which regulate them". Comte, who built up this system, declared that the knowledge of phenomena is relative, not absolute; he anticipated Einstein by a century in the promulgation of the doctrine of relativity; "Tout est relatif; voilà la seule chose absolue". The great French philosopher, the founder of the science of sociology, was one who practised even whilst he preached, and he had the good fortune to be widely appreciated during his lifetime, which is not invariably the experience of pioneers. He (like Cæsar, Gregory, and Omar Khayyám) also had views as to the reform of the calendar. In Comte's case it may truly be said that the good he did survived him, though it is the fashion of the day to consider him a 'back number'; or shall we say, a backwater? He proved, in his own life, how "That men may rise on stepping-stones Of their dead selves to higher things". The biographer has evidently regarded her labour as one of love; and though her sentences are too often breathless and some of her sentiments more than disputable, yet her book is eminently readable and will attract wide attention.

The Principles of Systematic Entomology. By Prof. G. F. Ferris. (Stanford University Publications, University Series: Biological Sciences, Vol. 5, No. 3.) Pp. 169. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1928.) 12*s.* 6*d.* net.

WE can commend this book to systematists in general, and to entomologists in particular. It discusses in a critical way existing methods of systematic entomology with suggestions for their improvement. The importance of taxonomy to-day can scarcely be overrated, and it is imperative that if work of this character is to stand the test of time, and not merely add to existing confusion, new species should be accurately and sufficiently diagnosed and, furthermore, adequately illustrated. As Dr. Ferris remarks—to add to the number of named species has too often assumed an undue degree of importance: too often it has nothing to do with any actual increase in knowledge; and too

often it merely adds more inadequately described species to the already long list of such encumbrances. We feel sure that if the contents of this book be taken seriously and the more potent of the suggestions acted upon, some of those who describe new species of insects will return to their work with a higher ideal, with more refined technique, and, perhaps, with a greater sense of responsibility.

Scoliodon (*the Common Shark of the Indian Seas*). By E. Muthammah Thillayampalam. (The Indian Zoological Memoirs on Indian Animal Types, 2.) Pp. xi + 116 (10 plates). (Lucknow: The University, 1928.) 2.8 rupees; 3*s*. 6*d*.

THERE are few publications for students dealing in detail with the structure and development of common Indian animals, and a committee of Indian zoologists is now issuing a series of memoirs to rectify this. Prof. Bahl wrote the first on the earthworm, and set a good standard which is well maintained in the present publication. The detailed study of types is necessary to teach accurate observation, and we trust that these memoirs will become a regular feature of the teaching of zoology in India. Surely the bibliography should be complete or consist merely of a few references to publications generally available in universities. We prefer, where possible, names or letters on drawings in preference to numbers, which few students will struggle to follow throughout. Yellow should never be used on any figure intended to be studied by artificial light.

Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus. By Dr. William Harvey. With an English translation and Annotations by Prof. Chauncey D. Leake. (Tercentennial edition.) Pp. vii + 74 + 154 + 8 plates. (London: Baillière, Tindall and Cox, 1928.) 16*s*. net.

THIS fine volume contains a facsimile of the original Latin edition published by Harvey at the age of fifty in 1628, followed by a free translation by Prof. Leake, who holds the chair of pharmacology in the University of California. We learn from the postscript that this is the third attempt to render Harvey's classic into current English idiom, the first being the work of an anonymous author in 1653, and the second the stilted and involved version of Dr. Robert Willis, who made a translation for the Sydenham Society in 1847.

Prof. Leake has added many instructive footnotes to his translation in order to illustrate the relation of Harvey's work to our modern knowledge of cardiac function.

The book contains two portraits of Harvey and a facsimile of his first note on the circulation made in 1616.

An Introduction to Biophysics. By Prof. David Burns. Second edition. Pp. xix + 580. (London: J. and A. Churchill, 1929.) 25*s*. net.

THE second edition of this text-book has been considerably enlarged, revised, and in places re-written. A new chapter on soaps and emulsions has been added; the sections on surface tension, general receptors, ear, eye, voice, and limb movements have been extensively revised. The illustrative experiments which form a separate section have also been largely rewritten as the result of several years' experience in the teaching of physiology.

For those who are unacquainted with Prof. Burns's work, it may be described as physical physiology or physiology from the point of view of mechanics and physical chemistry. Thus it includes, although in greater detail, much that is to be found in the standard text-books on this subject, but the problems are approached at a different angle. Both from the theoretical and the practical aspects the book will be of value to teachers and to advanced students, since it provides under a single cover a quantity of information which can only be found scattered through the literature. The illustrative experiments provide a good introduction to physical chemistry.

Rhythmische Phänomene der Erdoberfläche. Von Henning Kaufmann. Pp. v + 347. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 14 gold marks.

ON the surface of contact of two different media, such as air and water or water and sand, various rhythmic forms are produced when there is relative movement. The forms vary widely in kind and order of magnitude, and include sand dunes, ripple-marks, and river meanders. This book is devoted to a systematic account of the phenomena involved and the morphological features produced, and is useful as a compilation of observations and hypotheses, and as a bibliography of the subject. Unfortunately the physical treatment is weak and no mathematical discussion is presented. Although the book does not add any original contribution to the theoretical aspects of the rhythmic and periodic phenomena of geology, it will nevertheless serve a valuable purpose in providing geologists, geographers, and engineers with a most convenient summary of what is already known in a somewhat neglected field of investigation. The author deserves our gratitude, if only for his enterprise in tidying up a very scattered subject.

Wave Mechanics: being one Aspect of the New Quantum Theory. By Dr. H. T. Flint. (Methuen's Monographs on Physical Subjects.) Pp. ix + 117. (London: Methuen and Co., Ltd., 1929.) 3*s*. 6*d*. net.

THIS little book fills a definite gap in the literature of wave mechanics in that it gives in small compass a clear mathematical account of the variation principles of dynamics and optics, the analogy which points the way to mechanical waves, the nature of the problem and its solution. This may seem an ambitious task, but by confining himself to the simplest cases and by adopting a proper mathematical formulation, Dr. H. T. Flint has succeeded in producing an essay which is exact and intelligible. The bibliography on p. 113 reveals the identity of a person whose name is spelt Shroedinger in the preface and throughout the book.

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.*]

Early Rhodesian Mining and Zimbabwe.

MISS CATON-THOMPSON'S clear statement (NATURE, Oct. 19, p. 619) of her important contributions to the early history of Rhodesia, raises again the problem of the relations of the ruins and mining. Any one of four solutions may be possible: (1) Both ruins and mines may be prehistoric; (2) or both medieval; (3) or the ruins may be relatively modern and Bantu, while the mining may be exotic, may have been begun two or three millenniums B.C. and have been continued until Roman times, and to a small extent by the Arabs; or (4) some of the buildings may be medieval and rough copies of the ancient architecture—for it was the claim that some of the walls which MacIver proved to be medieval had been previously identified as such by South African archæologists, owing to the crudeness of the work, that rendered his results unconvincing.

Miss Caton-Thompson's article deals only with the ruins; but her statement that "it is inconceivable to me . . . how a theory of Semitic origin could ever have been started", and some remarks in the leading article in NATURE of Oct. 19, both imply that her excavations disprove the extraneous origin of the mining.

The view that the early gold mining of Rhodesia is medieval and Bantu is faced by difficulties which make students of mining history hesitate to accept it. Mr. Hays Hammond recognised at the opening of the Rhodesian fields that the amount of gold won from them was so immense that it must have been the main source of gold in early times. He estimated in 1894 that the amount was undoubtedly "millions of pounds sterling worth of gold". By 1897 more of the ancient workings were known, and Telford Edwards estimated their yield as £75,000,000. Further ancient workings have been discovered since then, so that this amount must be increased. According to some estimates the ancient miners removed 100,000,000 tons of ore.

Where did all this gold go? There is no evidence of its use in South Africa. The amount exported in medieval times to Arabia must have been relatively small. Which lucky country received it? Ancient Egypt and Chaldea imported large quantities of gold; and the only known early gold workings adequate for their supply are in South Africa. Tibet and southern Siberia must be considered as a possible source from traditions; but there is no evidence of extensive ancient gold workings in either. Mr. L. Woolley ("Sumerians", 1928, p. 116) quotes the bill of lading of a vessel that returned to the Persian Gulf in the year 2048 B.C., after a two years' absence, with gold, ivory, copper ore, etc. This record shows that some of the gold of Ur came from far to the south, and the Mysore gold field, the only southern alternative to Rhodesia, is improbable.

In addition to the inferences from the distribution of early gold mining and the nature of the Rhodesian workings, there is evidence of pre-medieval mining in Rhodesia, such as a Roman coin found in a shaft 70 feet deep near Umtali; beads referred to Ptolemaic Egypt and pre-medieval India; the use of ingot moulds of the X-shaped pattern used by the Phœnicians in Cornwall; soapstone birds similar to those used in Assyria and in the gold and turquoise mines of Egypt; a knobbed cylinder compared by Hogarth to one from Cyprus; the Groot Schur platter with the signs of the zodiac; inscriptions that have been identified as proto-Arabic and Semitic characters. Miss Caton-Thompson may regard these objects as all typically Bantu. But Sir H. H. Johnston, no mean authority on Bantu ethnology, declared (*Geog. Jour.*, vol. 37, p. 340) that except for "an incursion of a Semitic race of teachers I cannot otherwise explain the gold-mining, the soapstone birds, the phalli, and the several other features in these remains which are so utterly unlike anything that has ever been made by any race of Bantu negroes".

The leading article in NATURE refers to "this unique efflorescence of Bantu culture". Negative evidence has led some archæologists to deny the presence of Phœnicians in Britain. I understand that, with the exception of the tin ingot dredged in Falmouth Harbour, not a single Phœnician or Greek relic has been found in Cornwall. Yet the balance of opinion is still overwhelmingly in favour of the Cornish tin mining having been established under Phœnician influence.

The view that Zimbabwe may have been a medieval archæological museum where the Bantu collected the soapstone birds and ingot moulds of a then prehistoric people, and made crude copies of their own, is, of course, possible. But until some other explanations be offered of where the ancient Egyptians and Sumerians obtained their gold, where the gold from Rhodesia went, of the use by the early gold and copper smelters of Rhodesia of the Phœnician pattern of ingot mould, and of the resemblance of various objects to those of south-western Asia, the students of ancient mining will probably retain the belief that the early mining in South Africa was organised by foreigners who shipped the gold and copper to the Red Sea and Persian Gulf.

A note in NATURE of Sept. 28, 1928 (p. 493), summarises a paper by Dr. P. A. Wagner, which was read recently in South Africa, in which he extends the arguments for extensive mining in Northern and Southern Rhodesia, under alien influence, in times that were long pre-medieval. J. W. GREGORY.

The Late Palæozoic Glaciation.

PROF. SCHUCHERT, in his recent paper on the late Palæozoic ice age (*Bulletin of the Geological Society of America*, vol. 39, pp. 769-886), has strenuously fought for the view that the ice age is not older than Middle Permian. I have read with interest Dr. H. Dighton Thomas's article in NATURE (June 22, 1929, p. 946), and both I and, I think, all my colleagues of the Geological Survey of India, are in agreement with Dr. Thomas's views. It appears quite impossible to regard the whole of the Productus Limestone of the Salt Range as belonging to the Upper Permian only. I prefer to regard the Upper Productus Limestone of the Salt Range (Chidru beds) as Upper Permian, the Middle Productus Limestone with *Xenaspis carbonaria* as of Middle Permian age, and the Lower Productus Limestone with *Spirifer Marcoui* as Lower Permian. With the Middle Productus Limestone may be correlated, according to C. Diener, the bulk of the Zewan beds of Kashmir, and the fauna of exotic block No. 1 of Chitichun (*Pal. Ind.*, New Ser., vol. 5, Mem. 2, p. 110). Diener places the *Gangamopteris* horizon of Kashmir in the Lower Permian or Artinskian (*ibid.* p. 111).

In 1928, Dr. F. R. C. Reed and I visited Warcha Salt Mine in the Salt Range in order to examine the succession from the Glacial Boulder Bed upwards through the Permian to the Trias. The results of our

work are being published in the *Records of the Geological Survey of India*, and will shortly appear; meanwhile, it may be of interest to state such results as throw light upon the age of the Boulder Bed. In ascending order the succession in the Jansukh nullah at Warcha is: 1. Boulder Bed, 6 inches to 2 feet. 2. Green sandstones with coaly laminæ, 38 feet. 3. Purple and white pebbly sandstones, 277 feet. 4. Lavender clays (see *Mem. Geol. Surv. Ind.*, vol. 14, p. 90), 42 feet. 5. Carbonaceous sandstone, 27 feet. 6. *Fusulina* Limestone (lowest bed of Productus Limestone). This gives a thickness of 386 feet from the base of the Boulder Bed to the first bed of *Fusulina* Limestone.

In the adjoining nullah (Jarhanwala nullah) there is a very fine section of Productus Limestone. The sandy beds with the Boulder Bed at their base here also underlie the Productus Limestone. Their thickness could not be measured with the same accuracy as in the Jansukh nullah, but we were able to prove by measurement that the thickness was more than 290 feet. The section through the sandy basal beds is, however, obscured by screes and badly exposed. We were able, however, to measure the Productus Limestone with some success, especially its lower portion. The lower 225 feet of the Productus Limestone can be subdivided into small lithological units owing to the alternation of limestone with shale and sandstone. The higher horizons of the Productus Limestone are much more homogeneous. This lower division, 225 feet thick, of the Productus Limestone at Warcha is of exceptional interest, because about 40 feet from the top we found a carbonaceous bed with plant fossils (*Gangamopteris*, *Glossopteris*, and *Annularia*). If these beds are Lower Permian, the *Gangamopteris* horizon would correspond very closely with the *Gangamopteris* horizon of Kashmir (accepting Diener's age for the latter).

It is to be noted that the Glacial Boulder Bed is well below the *Gangamopteris* horizon, some 500 feet of strata intervening. From its stratigraphical position one would be inclined to place it in an older stage than that of the Lower Productus Limestone, and if the latter is Artinskian the Boulder Bed may reasonably be suspected to be Uralian in age. I may here note that Dr. F. R. C. Reed and I are of opinion that the lower beds of the Productus Limestone in the Jarhanwala at Warcha are to be correlated with the Lower Productus Limestone of other sections in the Salt Range.

The progress of the geological survey of Hazara by D. N. Wadia has indicated the Permian age of the Infra-Trias Limestone group of Middlemiss (see *Mem. Geol. Surv. Ind.*, vol. 26). Middlemiss had indicated the probable correlation with the Talchir Boulder Bed of the Tanakki Boulder Conglomerate which underlies the Infra-Trias Limestone south of Abbottabad. D. N. Wadia has recently strengthened this hypothesis by finding ice-scratched boulders in the Tanakki Conglomerate. Wadia also finds that the Infra-Trias Limestone in the Kaghan Valley in North Hazara is underlain by Agglomeratic Slate with interbedded conglomerates. He regards the Agglomeratic Slate as homotaxial with the Tanakki Conglomerate. If this be so, then the age of the Conglomerate is perhaps not later than Upper Carboniferous. Middlemiss and Bion ("Fauna of the Agglomeratic Slate Series of Kashmir", *Pal. Ind.*, New Ser., vol. 12) ascribe a middle to upper Carboniferous age to the Agglomeratic Slate. Middlemiss had previously (*Rec. Geol. Surv. Ind.*, vol. 40, p. 233) suggested that the Agglomeratic Slate was of similar age to the Talchir Boulder Bed.

From whatever side the question is viewed, it does not appear that the Indian sections give any support to Prof. Schuchert's theory. Further, his account of the Gondwanas of the Peninsula is not free from error. Thus, on page 851 of his paper, he lists *Gondwanosaurus* as coming from the Mahadeva-Maleri series, which, he states, is Upper Trias. *Gondwanosaurus* is of course Permian. On the same page he lists *Gangamopteris* and *Dancœopsis hughesi* as belonging to the Middle Gondwana. *Gangamopteris* is of course only found in the Talchir and Damuda series of the Lower Gondwana (Upper Carboniferous to Permian), while *Dancœopsis hughesi* is believed by all palæobotanists to be of Upper Trias or Rhætic age, and not Lower Trias to Upper Permian as Schuchert suggests. *Dancœopsis hughesi* is found at Parsora in South Rewah, and the beds from which it comes are very close in age to the neighbouring Tiki beds with Upper Triassic reptilian and amphibian fauna.

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New Phenonema in a Sounding Dust Tube.

WITH the view of making accurate measurements of the velocity of sound, and hence of the ratio of the two principal specific heats of gases, we have been studying the formation of dust figures in a sounding tube. Instead of using a stroked rod to produce the vibrations of known frequency, as Kundt did in the form of experiment known by his name, we employ a telephone diaphragm (actually a loud-speaker unit) excited by a current of approximately pure sine-wave form, which is produced by a suitable valve circuit. The frequency of the vibration is then varied until one of the resonant frequencies of the tube is reached, when the dust phenomena are produced with great distinctness and can be studied at leisure.

Many features of the dust movements which have apparently hitherto escaped observation have been

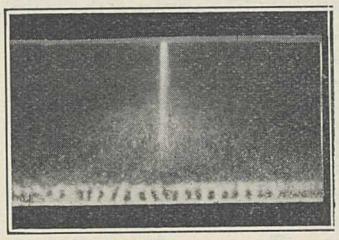

FIG. 1.

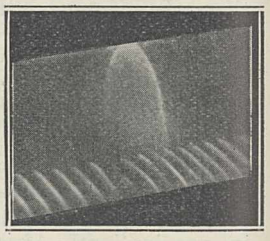

FIG. 2.

observed with this technique. One of the most important is the formation of clearly defined discs of dust particles, which extend across the tube, like barriers, *at the antinodes*. These discs are of surprising sharpness, being, in favourable cases, not more than a millimetre thick, while the crosswire of a reading telescope can be set on the central plane of a disc to within a tenth of a millimetre. The formation of these discs will be discussed in a forthcoming publication, but their definiteness, to which we wish to direct attention, is clearly shown in the accompanying photographs (Figs. 1 and 2), Fig. 1 showing a disc as seen from a horizontal direction normal to the axis of a tube, and Fig. 2 a similar disc as seen obliquely and from somewhat above the tube. Fig. 2 also shows the sharpness with which the 'ridges' are developed in our experiments, which have sufficed to convince us that the explanation generally given of the formation of these ridges is untenable.

Measurements of the separation of the antinodal discs permit determinations of the velocity of sound to be made with much greater precision than can be secured by the usual Kundt's tube method. Pre-

liminary experiments with air have shown that the velocity can be easily determined with an accuracy of 1 part in 300, probably 1 part in 1000. The frequency of the vibration is measured by sending the current through the wire of a string galvanometer and recording the movement of the wire photographically, with the record of a standard tuning fork as a comparison. The accurate running of the fork is at present fixing the limit of accuracy.

Other observations are concerned with the behaviour of very small particles which take up practically the full amplitude of the air vibration, and appear as little lines of light when strongly illuminated. The lines, or 'needles', as we have called them, have a length of some millimetres when the tube is run on the fundamental note with one end open. They have also been observed, if in a less developed form, by M. Z. Carrière, and described by him in a paper in the *Journal de Physique* for May 1929, a note of which in the research items of NATURE of Sept. 28 directed our attention to it. The independence of our observations is established by the fact that we showed these needles publicly in a demonstration at the Royal Institution on Friday evening, Mar. 22, before M. Carrière's paper was published. Whereas M. Carrière records that he failed to photograph the needles, we have succeeded in obtaining very definite photographic records, of which Fig. 3 is an example, which shows both larger and smaller particles, the larger ones not taking up the full amplitude of the air vibration. The effect of a sideways drift of some of the particles, which develops a sinusoidal form for the path, is also clearly visible. Measurement of the length of the finest needles seems likely to lead to interesting results.

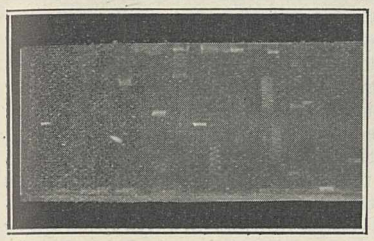

FIG. 3.

E. N. DA C. ANDRADE.
S. K. LEWER.

Physics Laboratory,
University College,
London, W.C.1, Oct. 11.

Dew: Does it Rise or Fall?

DR. SIMPSON (NATURE, Oct. 12, p. 578) has misstated my view. It is clear that when I wrote real dew rises as vapour from the ground I referred to the source of the dew and not to the dew itself, and therefore regarded as vapour "it may be said" to rise. It was therefore unnecessary for Dr. Simpson to point out that dew is water and not water vapour. I have given some time to the study of dew, and though Dr. Simpson offers the generally accepted explanation of its formation, it is curious to observe how capriciously dew appears to deposit, some objects remaining quite dry on a dewy night, whilst others in close contact are covered with moisture.

In general the phenomena can be readily accounted for by vapour from one or other of the sources mentioned in my former letter.

Dr. Simpson says we have no word to describe water condensed in the air. In a paper published in the *Quart. Jour. Royal Meteorological Soc.*, vol. 30, No. 131, I gave it the name of *false dew*, which seems to me to answer the purpose.

J. B. COHEN.
1 North Grange Mount,
Headingley, Leeds.

DR. SIMPSON pronounces that it does neither (NATURE, Oct. 12, p. 578), and there is only one point that I find a difficulty in following in his very clear interpretation of the formation of dew.

"The dew", he says, "is nowhere" until it appears on the surface of objects whereof the temperature has fallen below that of the surrounding air. If that be the only process in the formation of dew, how is hoar frost to be understood? For, says Dr. Simpson, "hoar frost is true frozen dew". Are we to assume (it would be difficult to prove) that the surface temperature of leaves and other objects had fallen below the dew point before the surrounding air fell below the freezing point? Or does a lower temperature of the air cause the moisture in it to be condensed in the form of hoar?

Dew, whether liquid or frozen, lies almost wholly on the upper surface of leaves, etc. It must, therefore, be chiefly derived from the air above such objects, and to that limited extent perhaps the poet may be justified in declaring that—

"Maxwellton braes are bonny
Where early fa's the dew".

HERBERT MAXWELL.

Monreith, Whauphill,
Wigtownshire.

I AM sorry that Dr. Cohen thinks I misstated his views: but after comparing his letter (NATURE, Sept. 28, p. 482) and my letter (NATURE, Oct. 12, p. 578) very carefully I cannot see his point. I only referred to Dr. Cohen twice in my letter: in the first case I wrote: "Dr. J. B. Cohen . . . says it does both", while his actual words were: "I think it may be said to do both"; in the second case I wrote: "Both Sir Herbert Maxwell and Dr. Cohen speak of the water vapour first condensing in the air before appearing as dew"; Dr. Cohen actually wrote: "The cold air tends to cool the objects with which it is in contact and the water vapour present in the warmer air is thereby condensed. Mist over water and marshy ground is formed in this way and this dew may therefore be said to fall". I wish to be helpful in this correspondence, and if Dr. Cohen will be good enough to say in what particular he cannot accept my explanation of dew formation, I will do my best to elucidate the point.

From Sir Herbert Maxwell's letter and a personal letter I have received from Dr. Leonard Hawkes, it appears that my phrase "hoar frost is true frozen dew" has led to misconception. Taken alone it might be read to mean "hoar frost is dew which has been frozen", but when read as part of the sentence in which it appears this reading should be impossible. Still it would have been better to have avoided the ambiguous wording. Sir Herbert Maxwell's difficulty, however, does not appear to be concerned entirely with my wording. I should, therefore, like to amplify my previous letter.

In the process of the formation of dew or hoar frost we are not directly concerned with the temperature of the air; the only two temperatures which come into play are the temperature of the cooling body (say a blade of grass, to fix the attention) and the temperature of the dew point of the air. When the temperature of the blade of grass falls below the dew point owing to radiation, condensation takes place on its surface, and if the dew point is below the freezing point the product of condensation is ice—even though the air temperature is above the freezing point, as it may well be. Ice formed in this way is hoar frost.

When mist forms in air below the freezing point, the mist particles remain liquid, but super-cooled,

until they strike an object, when they solidify on contact. Thus bodies exposed to mist or fog at low temperatures become covered with a coating of light fluffy ice to which we give the name of 'rime'. In certain conditions of thin mist hoar frost and rime may both be formed at the same time.

G. C. SIMPSON.

Meteorological Office,
Adastral House, Kingsway,
London, W.C.2.

Empirical Factors in Weather Forecasting.

THE Meteorological Office always welcomes friendly and constructive criticism, and therefore it gives me much pleasure to reply to the points raised by Mr. Wilfred Trotter in his letter published in NATURE of Oct. 19. Mr. Trotter's main indictment is that modern British forecasts prepared on synoptic charts take too much account of the pressure systems shown on those charts and too little of that general tendency for persistence of weather which sometimes seems to cause fine weather to continue for a long unbroken spell with little regard to the pressure distribution. It would be idle to deny that there may be some truth in this charge, but perhaps I may point out some of the difficulties with which the forecaster is faced. Let us take as an example a case which was fairly common during last summer, when a trough of low pressure over Ireland, stretching down from an Icelandic depression, is moving eastward across the British Isles and probably already giving some rain in Ireland. The question to be answered is, Will this rain spread to the south and south-east of England? The forecaster knows from his experience that in normal circumstances it will generally do so. In the particular type of weather which we are discussing he also knows that the past month or past few months have been abnormally dry. There are these two conflicting elements to be balanced. If he leaves out rain and it comes, he fails in what to many people is the most important factor of his forecast. He decides that he cannot take this risk with no better grounds for the omission than the somewhat nebulous one that the summer has so far happened to be abnormally dry. He therefore indicates the probability of some rain; when he comes to the office the next day and reviews the situation, he may wish that he had taken the risk and left out the reference to rain. It is easy to be wise after the event. It must be remembered that, even in a dry summer like the past, there have been days when troughs of low pressure have given rain in the south of England, so that if the forecaster had omitted to mention it on every occasion, he would in some cases have been wrong, and badly wrong.

There is a further point. The Meteorological Office has to forecast for the whole of the British Isles, and it frequently happens that drought in one part of the country coincides with excessive rain in another part. We have been taken to task already this summer for not making enough mention of heavy rains which fell in the West Highlands of Scotland. The forecaster, therefore, who is looking at the whole of the country may not have the dryness of the season impressed upon him quite so strongly as members of the public who see the weather in their own locality only, and from the nature of the case take little account of that in other areas. We have been aware of this tendency to forecast rain more frequently than the event proves to be necessary in dry spells for many years, and if we have failed to benefit by experience, this is due more to the difficulty which I have tried to indicate above than to ignorance of the facts. The cure will be found in more science, not less. When we really understand the workings of the atmosphere and have enough upper air observations to tell us what is happening at the time, we shall know that the particular trough which is approaching cannot bring rain; but that time has not arrived yet.

One further criticism is made by Mr. Trotter, and that is with regard to the forecasting of summer thunderstorms, his charge being that too little account is taken of the time of year and that thunderstorms are forecast as confidently in the latter part of August, or even in September, as in the middle of July when the thunderstorm season is at its height. The forecasting of thunderstorms is perhaps the branch into which more scientific method has been introduced than into any other branch of forecasting, and much account is now taken of whether the upper air conditions, as shown by aeroplane ascents, are stable or unstable. Nevertheless, these observations are not always available when required, and then the older methods of forecasting by pressure distribution and surface temperature have to be used exclusively.

I have not statistics available to show whether Mr. Trotter is right in thinking that the trustworthiness of the forecasts of thunder declines steadily throughout August. The average number of days of thunder at Kew Observatory in August is equal to that in July, and higher than in any other month of the year, though the September figures show a sharp drop. Recent criticisms of our forecasts have suggested that we forecast thunder too often throughout the whole summer, and I believe that this is largely due to the fact that any individual observer is concerned only with the thunder in his immediate vicinity, whereas our forecasts cover a whole district. If a thunderstorm is likely in any part of that district, we do not feel justified in omitting it from the forecast. The number of days in an average summer when thunder is reported at a few isolated places but by no means generally over a district, is very considerable.

J. S. DINES.

Meteorological Office,
Adastral House, Kingsway,
London, W.C.2, Oct. 25.

The Motion of a Lorentz Electron as a Wave Phenomenon.

I HAVE been able to express the equation representing the uniform motion of the surface of a Lorentz electron in a form which strongly suggests that the 'parcel' or particle aspect of the phenomenon may be associated with the interference of two waves. Thus, if (x, y, z) are Cartesian co-ordinates relative to a material observer and t is his proper time, the motion of the electron's surface is represented by

$$\frac{(lx+my+nz-c\beta t)^2}{1-\beta^2}+(\lambda x+\mu y+\nu z)^2 + (Lx+My+Nz)^2=a^2,$$

where (l, m, n) are the direction cosines of the velocity $c\beta$ and a is the rest radius. On account of relations of the types

$$l^2+\lambda^2+L^2=1,$$
$$lm+\lambda\mu+LM=0,$$

this is reducible to

$$\phi(x, y, z, t)=a^2, \quad . \quad . \quad . \quad (1)$$

where

$$\phi(x, y, z, t)\equiv\psi(x, y, z, t)+\frac{1}{{m_0}^2c^2}\{W(x, y, z, t)\}^2, \quad (2)$$

$$\psi(x, y, z, t)\equiv x^2+y^2+z^2-c^2t^2, \quad . \quad . \quad (3)$$

$$W(x, y, z, t)\equiv\frac{m_0c\beta}{\sqrt{1-\beta^2}}\left(lx+my+nz-\frac{ct}{\beta}\right) \quad . \quad (4)$$

(m_0 is the rest mass of the electron). The function ψ

represents a Maxwellian wave surface travelling with the fundamental velocity c, and the function W is the action function and consequently represents a de Broglie-Schrödinger wave surface travelling with the velocity c/β. Relative to an observer travelling with the velocity c, the Maxwellian function ψ disappears from W, and the Schrödinger wave surface coincides with the surface of the electron, both in fact reducing to a plane Maxwellian wave surface

$$l_1x_1 + m_1y_1 + n_1z_1 + ct_1 = 0, \quad . \quad . \quad (5)$$

where the suffix 1 relates to the new observer. This suggests that our electrons would appear from a ray of light as rays of light, and a similar argument may show that our rays of light would appear as electrons. This reciprocal relation between matter and radiation involving a dual aspect of each, if accepted as a principle, may help to elucidate problems of interaction between these two fundamental entities of physical science. Fuller details will be published later.

A. M. MOSHARRAFA.

Egyptian University,
Cairo, Sept. 19.

Magnetic Reaction of Carbon Filaments.

AN ordinary magnet, or a current carrying winding adjacent to the filament of a carbon filament lamp, produces the oscillation shown in the accompanying photograph (Fig. 1) when the filament is glowed, the effect commencing at the dark heat radiation point and increasing with increasing filament radiation.

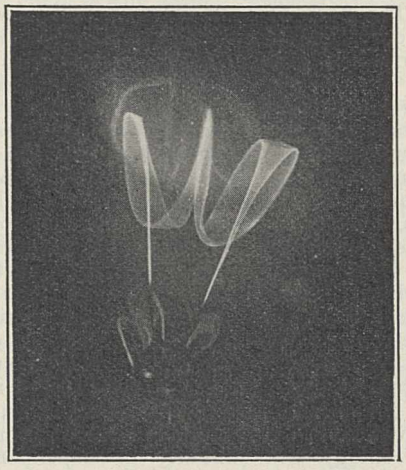

FIG. 1.

When filament and winding currents are both direct, simple distortion occurs. The cold filament placed in actual contact with a magnet shows no affinity thereto.

It thus appears that, when radiating, the carbon filament assumes magnetic properties which may be due to

(1) Decrease of inertia of the filament ;
(2) Atomic rearrangement ;
(3) Impurities in the filament.

Regarding the last, some filaments have been produced from a colloidal zinc salt.

As a matter of interest, tungsten and tantalum filaments gave no magnetic reaction, though it should be said that these filaments are more rigidly supported than the carbon type.

The best results are obtained with a carbon filament lamp having large and few filament coils, for example a 150-volt size.

Using a horseshoe magnet, positions of maximum magnetic disturbance will be found when the poles are in the planes of the coil axes, the effect decreasing gradually towards the mid-points.

CEDRIC W. MARSHALL.

Sandfield, Headingley,
Leeds.

Rearing Experiments with Starfish and Obstetric Toads.

PERHAPS readers of NATURE would be interested to hear the results of two rearing experiments which were carried out under my supervision this summer by two of my pupils in the Zoological Laboratory of the Imperial College of Science.

(1) The common starfish, *Astenas rubens*, was obtained from Plymouth. The eggs were artificially fertilised and the larvæ were reared through their entire development, until they metamorphosed into young starfish—a process which occupied 2½ months. This feat had been accomplished in Plymouth and in Millport, but this is the first time that it has been done with eggs which travelled 226 miles from the sea. The development and beating of the larval heart were studied. Mr. Murtri, the pupil who carried out the experiment, also studied the development and beating of the larval heart of *Echinus miliaris*—a species which we rear in our aquaria through its entire development every year. The heart of *Echinus* beats almost four times as fast as that of *Asterias*.

(2) Through the kindness of Mr. E. Boulenger, director of the Aquarium of the Zoological Society, a consignment of thirty specimens of *Alytes obstetricans* were obtained from Germany. These were entrusted to the care of my pupil Miss Sladden, who has great skill in rearing Amphibia. Eighteen of the specimens were removed to our greenhouse, in which a temperature of from 80° to 85° F. was maintained to see if they would become acclimatised, but almost all of them died within a few weeks. The remaining 12, including two males carrying eggs, were kept under approximately natural conditions and all survived. Each of the two males carried from 30 to 40 eggs ; from each batch 20 tadpoles hatched out. Of these 40 tadpoles, no less than 38 were successfully reared through the metamorphoses. After metamorphosis 18 of the young toads were transferred to the greenhouse, 10 were transferred to an out-of-doors vivarium, and 10 to an indoors vivarium. The little toads are now two months old, and only one has died—that one being amongst those subjected to warmth.

Thus Kammerer's statements that *Alytes* could become acclimatised to a high temperature and that in these circumstances it would revert to a water-inhabiting life have been confirmed. Whether we shall have the skill, resources, and time to rear further generations of *Alytes* is still on the "knees of the gods".

E. W. MACBRIDE.

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London, S.W. 7.

Age of the Tahitian Coral Reefs.

DR. CYRIL CROSSLAND (NATURE, Oct. 12, p. 576) refers to my discovery of coral fragments in a parasitic tuff-cone at Tataa Point, at the north-west corner of Tahiti. The size and water-worn character of these fragments and of the associated basaltic pebbles in the tuff suggest that the cone was built by eruptions through an old beach sprinkled with coral debris. Had the eruption burst through a solid reef, it may reasonably be supposed that large angular blocks of

coral would be found. Dr. Wayland Vaughan and Dr. J. E. Hoffmeister agree as to the age of the corals. The latter writes: "Most of the fragments seem to belong to *Porites*, two to *Acropora*, two to *Pavona* and two to *Pocillopora*. The *Pavona* is of the same type as *P. duerdeni*, Vaughan, or *P. maldivensis* (Gardiner), which are common in the Pacific of to-day. As Dr. Vaughan has said, there is nothing in this collection which might lead one to suspect that they are older than Pleistocene." He adds that among a collection of recent corals, made by Prof. Setchell, from the barrier reef off Papeete Harbour, he can find none common to the Tataa fauna.

Only one-third of the Tataa cone now remains, but it is clear from the attitude of the bedding that the original vent lies beneath the lagoon, and that the outer edge of the cone formerly extended on to the site of the present barrier reef. The denudation of the cone must have occurred before the rise to the surface of the barrier reef, since it cannot have been effected by lagoon currents alone. Moreover, the trend of the barrier reef ignores the original outlines of the cone.

At the exposed base of the cone, that is, at the edge of the lagoon, the tuffs lie either horizontally or roll at low angles, and in places, for a few inches above water-level, they show current-bedding. At higher levels the dips of the tuffs increase to 30° away from the lagoon. It seems, therefore, that the basal tuffs were laid down at sea-level. From the foregoing it appears that since the formation of the Tataa cone the growth of the barrier reef in this part of Tahiti has been unaccompanied by any subsidence of the land relative to sea-level. Unfortunately, there seems to be no evidence as to the depth from which the reef grew during this period.

HOWEL WILLIAMS.
Geological Department,
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Oct. 21.

Science and Parliament.

IT must be gratifying to all readers of NATURE to learn from the leading article in the issue of Oct. 26 that science will now have a group of members of the House of Commons who will, to some extent, look after the interests of the country in matters where science is concerned. This is due to the secretary of the Association of Scientific Workers, a body which is devoted to furthering the interests and usefulness of all who are engaged in scientific work. There is, so far as I know, no other body with the same aims; at least none which represents all branches of science. I say all branches of science because it can scarcely be said to represent—unless it be vicariously—all scientific workers, as its numbers are small compared with the great number of possible members. Those who know of its work realise that in its brief existence it has done a great deal to forward the interests of science. The increase in the Treasury grant for scientific publications was obtained through the efforts of this body, which has also done much useful work of a kind that cannot well be made public.

The membership of the Association of Scientific Workers has never been large, although it has always been representative. Now that it has in a definite way, as stated in the leading article in NATURE, become actively connected with the Parliamentary Committee, those scientific workers who have hitherto refrained from joining would do well to consider if the time has not come when they should do so. Certainly, if science is to become powerful in Great Britain, it will be necessary for all its votaries to band together in support of the only organisation which seems likely to be able to bring this about. If this is not done, the work will be crippled for want of funds. It cannot be expected that the British Science Guild and the British Association will be able or willing to subsidise the Association, and the present membership is insufficient to provide the necessary funds. A largely increased membership is needed, not only for this purpose but also that all shades of opinion and all groups of workers may contribute their quota to the coherent expression of the aims of British science and to the setting forth of its willingness and ability to assist in guiding the destinies of the Empire.

J. H. COSTE.
Teddington, Oct. 26.

Properties of the Electron.

IT has been shown by me (*Phil. Mag.*, **7**, p. 493; 1909) that some of the main difficulties of the Bohr atom disappear if the electron possesses the property that it absorbs radiant energy during its motion, which induces a decrease of its electrical field, and under certain conditions ejects again the energy as radiation. A deduction of these properties was given based on thermodynamics and kinetic theory, which will be further elaborated in subsequent papers. The results may also be obtained in other ways, one of which will be pointed out here.

Suppose that an electron gas kept at constant temperature is subjected to a powerful magnetic field. The path of each electron will now possess greater curvature than before, resulting in an increased transformation of its kinetic energy into radiant energy, due to the acceleration it undergoes. A limiting case is that the concentration of the electrons is so small that in most cases they pass clear across the chamber. Thus the kinetic energy of the electrons will continually decrease. But this is manifestly an absurd result. Hence each electron will, on the average, recover its velocity during collision. This can take place only at the expense of the surrounding radiant energy, since the kinetic energy lost took this form. If radiation has the orthodox form, namely, that it consists of continuous electromagnetic waves, the electron can recoup the lost energy only by the gradual absorption of radiation which is stored up as internal energy. Since the emission of radiation due to the acceleration of the electron depends on the curvature of its path, the rate of absorption of radiant energy will similarly be dependent. The increase in velocity during a collision of the electron can be produced only by an increase in its field during the process, its internal energy supplying the necessary energy. Hence its field decreased during its mean free path.

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Distribution of Medical Works.

WE have been so much struck with the justice of the reviewer's comments in NATURE of Oct. 26 upon the limitation of the sale of Dr. Van de Velde's book, "Ideal Marriage", that we have decided for the future to sell it, not only to members of the medical profession, but also to biologists and other men of science, psychologists, sociologists, and representatives of scientific education and research.

WILLIAM HEINEMANN (MEDICAL BOOKS) LTD.
J. H. A. ELLIOT, Managing Director.

Imperial Mycology.

THE second Imperial Mycological Conference was recently held under the auspices of the Imperial Bureau of Mycology, the first having taken place immediately before the Imperial Botanical Conference in 1924, when it was resolved that a Conference should be held every five years. The Imperial Bureau of Mycology has as its work the assisting of overseas phytopathologists and the publication of an abstracting journal of applied mycology.

A Conference such as the one just held is advantageous for many reasons, most of which are obvious when one considers the comparative isolation of several of the workers in this vast subject. Moreover, the necessity for appointing plant pathologists or mycologists was recognised only comparatively recently in many parts of the Empire, with the result that several of the men who hold such posts have obtained their training and experience since the War. With great responsibilities, it is to their advantage to meet men similarly engaged, whether the crops with which they have to deal are the same or not. Planters as a class are interested merely in the successful growing of crops, and no matter what the crop or which the region, the chief interest of the phytopathologist as such is the same. Consequently, it was a wise move to issue a somewhat general invitation to home workers to contribute to the discussions.

A further point is that these conferences enable a degree of co-ordination of policies, and a taking stock of the present position of research in several matters of outstanding importance. Thus there was a discussion on virus diseases, which are so prominent in all pathology, one on the root diseases of orchard and permanent crops, one on the epidemiology of some cereal diseases, and one on fruit storage rots. Furthermore, the opportunity was taken to define the lines on which meteorological records and forecasts could best be utilised in the more exact timing of preventive spraying against crop diseases. Some of these matters would have been discussed whether or not they had a place in the formal programme, and the time given to them probably marked out the scope for extra-mural talks.

The resolutions which were passed at the close of the Conference give a summary of the main trend of the proceedings, and show the large part played by matters directly and indirectly concerned with plant protection. To aid in a discussion on the existing organisation of plant pathological (plant protection) services in various parts of the Empire, a list was compiled giving the branch of government service under which plant protection is placed, the members of the scientific staff, the inspectorate and co-operative personnel and 'projects under way'. The increase in the numbers of plant pathologists in some countries (for example, Canada) during the past few years is striking, and doubtless explains to some extent the claims of British universities that there is a great demand for biologists overseas; a friendly rivalry to create the most efficient research and administrative service may keep the demand steady for some time, but the proportion of workers trained overseas is steadily increasing.

A change comparable with that in the number of plant pathologists is seen in the plant protection regulations of the dominions and colonies. Much has been made of the political and economic aspects of certain recent regulations which have as their avowed object the prevention of the introduction of disease, but the experience of the United States with chestnut blight and pine blister rust, to take two well-known examples, are sufficient warrant for measures analogous to those for dealing with plague, cholera, or small-pox. The chances of introducing a 'new' disease into a country are nowadays almost incalculable, and when air traffic attains the dimensions prophesied for it we shall have to take other factors into account, for plant disease is more easily disseminated than human disease.

There is considerable diversity in the regulations of the different overseas areas, and it would doubtless ensure that they were more efficiently carried out if there was some standardisation. Obviously, there are difficulties in co-ordinating legislation for widely separated areas, but differences between that of say Kenya, Tanganyika, Uganda, and Zanzibar seem unnecessary. The Conference recommended that countries between which planting material frequently passes should endeavour to group themselves together to investigate the possibility of finding a minimum treatment for any specific pest or disease of a particular plant of which the export is desired.

Most of the dominions and colonies have taken measures to exclude specific plants either completely or from certain countries; sometimes all plants from certain places are excluded. Frequently, specified plants are allowed entrance subject to licence from the local authority, the conditions of the permit not usually being published though sometimes obtainable by intending importers. This is carried so far in Tanganyika that no living plant may be imported except under permit. Where well-known diseases are in question, official certificates are often required, usually to the effect that the disease is not known either in the country or in the district of origin; or only varieties proved to be immune are allowed entry. Many governments require the specified plants to be grown for some time in quarantine, and the Conference was of opinion that such provision should be included in all plant protection legislation. Most governments provide for the compulsory examination of all plant imports and the destruction or treating of plant packings.

Such regulations refer to the importing of plants, and countries wishing to export have to take them into account. But, as in human disease, the health service of the country itself is of chief concern, and import regulations are only an attempt to prevent the spread of disease to crops grown

within a given area. The measures for what is sometimes called 'internal plant protection' need not be co-ordinated between the different overseas countries; what is needed is that the most efficient methods for ensuring healthy crops be adopted, and this is a matter for each individual government. Usually, inspectors are appointed with powers to inspect crops and to prescribe specific treatment. The authority to destroy diseased plants may rest with the inspector but ranges up to a Minister; and similarly with powers of quarantine which may involve whole districts. Usually, compensation is payable at the discretion of the government, but this may be restricted to the destruction of healthy plants. Further, a grower may be compelled to destroy all dead plants of a crop, or may be forbidden to allow cultivated land to run wild unless the crop is destroyed.

A somewhat different aspect of the matter is seen in South Africa, where the majority of growers in an orchard area may request that the provisions of the Orchard Cleansing Act be applied to that area—and in Kenya, where a coffee plant may not be moved to another estate except under permit from the Director of Agriculture.

That special attention should be given to nurseries is obvious. It is usual for registered nurseries only to be allowed to offer plants for sale under an annual certificate of inspection and freedom from disease.

Most countries issue certificates of health for exports where needed, and occasionally no export is allowed without such a certificate. The Conference was of opinion that the system of certificates should be universally recognised, and drew up a form of certificate for approval and adoption.

Plant protection is given a more familiar bias in South Africa, where it is the declared policy to permit only imports of varieties or species that cannot be procured locally in adequate quantity and quality. Permission to import plants or cuttings is not given if seed will do. Here we have a similar regulation to the one which caused considerable uproar when passed by the United States a few years ago, and has meant so much 'dumping' of Dutch bulbs into Great Britain. The reference to seeds is interesting; for seeds seldom appear to be subject to import regulation. It is becoming recognised that seed-borne diseases are more important than was previously considered, and as the result of a discussion, the Conference suggested that the subject should be given increased attention throughout the Empire.

The need for a series of handbooks on the diseases of tropical and subtropical crops is much felt by those who are concerned mainly with two or three of these crops, for information is scattered over many periodicals. A subcommittee which was appointed to consider this drew up a list of eleven subjects and a provisional scheme of treatment, but it emphasised that "the series must be of outstanding merit, otherwise it would be preferable to drop the scheme altogether".

The difficulties met with in tracing accounts of the diseases of a given crop are as nothing when compared with that of finding a way through the tangle of the literature of mycological taxonomy, and it is well worth noting that, in a Conference where the so-called practical side of mycology was rightly predominant, the first resolution passed concerned systematy. It was decided to refer to the International Botanical Congress the necessity for an abstracting journal of the world's literature on mycological taxonomy. This indicates a more general interest in pure mycology than has been apparent during recent years, and one which, if it is developed in the spirit of those men who have done most for phytopathology both at home and in the overseas Empire, will surely bring forth abounding results.

Search for an Oil-Pool in Kent.

By HENRY B. MILNER.

ONE would have imagined that the history of oil exploration in the British Isles was sufficiently common knowledge to shake the faith of the most ardent believer in undiscovered resources, but apparently not. The attack on sub-Wealden hydrocarbons has broken out afresh, this time in Kent, and the possibilities of great finds of oil are optimistically envisaged. We are informed that permission has been granted by the War Office for a well to be put down on land given over to the rifle ranges near Hythe, and that the operators responsible for the project anticipate a 'strike' at about 1000 ft.

It would be interesting to learn the technical grounds (if any) on which hopes of such a discovery are based. That competent geological opinion has been sought, or that this proposed venture is the result of closely reasoned evidence, it is difficult to believe. We thought that the myth of enormous natural gas reserves, of which Heathfield, Sussex, was once considered to be an active indication, had been exploded long ago, so far as the Weald was concerned; maybe this present project has been conceived quite independently of any regard for what the concealed rocks of Sussex may or may not hold, though we can scarcely credit even elementary geological conceptions with disinclination to associate the two possibilities.

The geological column beneath Hythe cannot fail to be a most interesting and scientifically important link in the chain of evidence of the pre-Cretaceous rocks of the coastal margin of the Weald; to this extent a deep boring, carefully logged and sampled, is a most welcome happening. Presumably the operators in question have some idea of the rock succession they propose to traverse, and one is led at once to speculate on what data they rely for their forecast, not only of the occurrence of petroleum, but also of the rocks with which

it is destined to be associated. They at least have one or two theories to work upon; it is not improbable that they have consulted some of the official records of deep borings in the neighbourhood, or the learned papers on the concealed rocks of the county. But even these can only serve as an approximate guide to circumstances, as underground conditions are obviously changing rapidly beneath this corner of Kent, and a great many things may happen to which existing evidence affords not the slightest clue. Hythe and its environs, in fact, constitute rather a blank spot in our present knowledge of subsurface tendencies, and it will be certainly an enlightening development if this boring goes to any great depth.

Arguing on the estimate of oil occurring at about 1000 ft., we can safely dismiss the possibility that Palæozoic pools are the object of the search; this is all to the good, since it saves any discussion on 'coal-oil' relationship and will not be an encouragement to those who advocate the universal application of White's theory to reconsider the problems and deeper significances of the Kent coalfields. In point of fact, the supposed reservoir must be looked for much higher up in the geological scale, and we are forced back to our old friends the Portland Sand and underlying Kimmeridge Clay, the former to contain the pools, the latter (presumably) the mother-rock. Other horizons, the Oxfordian and Liassic clays, even if potentially oil-bearing rocks (which is more than doubtful), may be excluded either on account of possible absence or great depth at which they occur in a synclinal structure.

There is little doubt that the Kimmeridge Clay, as a formation, is mainly responsible for the bituminous manifestations in sub-Wealden rocks, especially the natural gas of Heathfield, and that where the Portlandian assumes a dominantly sandy character, it acts as a natural reservoir rock, a feature denied to the subjacent clay by the noteworthy absence of 'open' beds throughout its development. There is equally little doubt that small quantities of mineral oil do occur in association with these beds, but these are so insignificant as to be unworthy of more than passing mention. The conditions governing the formation and subsequent changes in the Kimmeridgian deposits were plainly biased to the production of oil-shale rather than liquid petroleum, with a minor accompaniment of a somewhat dry and very 'marshy' natural gas, conditions which can be paralleled in many other regions of the world. There is absolutely no technical evidence in favour of the possibility of this formation yielding oil in quantity either to indigenous reservoirs or to suitable containers above it; this applies to its development all over the country. It is, therefore, difficult to believe that it has changed its character beneath this small patch of Kent.

This, however, is not all. Even granting that the Kimmeridge Clay may have locally assumed the dignity of a prodigious oil-bearing mother-rock, if there is one place where one cannot be quite certain of the immediately overlying succession, it would seem to be Hythe and Romney Marsh. Beneath the normal Greensand of this locality the Wealden deposits occur, at least 500 ft. thick, increasing seawards by virtue of a synclinal attitude. The base of these beds may rest on anything from Purbeckian to Kimmeridgian: in other words, it is quite within the realms of probability that the Portlandian may be cut out altogether, as we know from the Elham boring, for example. In such an event, the prospective reservoir ceases to exist (since the lowermost beds of the Wealden are lithologically 'tight'), and any oil occurring in the Kimmeridge beds is still not much more mature than the idle globule.

There is, however, some evidence that the Portlandian deposits thicken westward beneath the Cretaceous cover, and this affords a chance of there being a small but suitable development beneath Hythe of the desired reservoir rock. A rough calculation from available data makes it apparent that, given the subsurface sequence to include the Portlandian, a 1000 ft. well would land just about in the middle of that formation, and this, supposedly, is the goal of the adventure.

Assuming, therefore, that the well-log ultimately demonstrates this anticipated sequence, we arrive at results which are familiar from many of the deep borings in Kent and elsewhere in the Weald, and there is not the least hope of the Portland-Kimmeridge combination proving more attractive as regards oil at Hythe than at any other locality.

Throughout these notes we have taken but little account of structure except to mention casually a general synclinal tendency. There is little doubt that the Jurassic rocks in this part of Kent are thickening considerably as traced from north-east to south-west, one of the main arguments in favour of Lamplugh's sub-Wealden geosyncline. Although some kind of anticlinal structure is favoured with regard to oil accumulation in general, admittedly it is not an essential condition. There seems to be no suggestion of anticlinal developments in the subsurface rocks of Hythe; on the contrary, the relevant beds in connexion with this supposed oil-pool have a decided seaward dip, if our reconstructions are correct; they are, in effect, part of the syncline. Now oil can occur in synclinal structures, but only under very precise conditions in which hydrological factors are peculiar; there is definite evidence that such hydrological circumstances are far from being realised in this part of England, hence we can hold out no hope of a unique synclinal accumulation. Thus does the conception of controlling structure prove equally discouraging.

It is, perhaps, a little unfortunate that the best site for the well should have been picked on Government ground, since it suggests that there may be some official backing for the enterprise. If this is so, we may at least plead for one important thing: that the boring be officially inspected from time to time and a record of the beds traversed compiled by competent authority, preferably the Geological Survey. If the oil be elusive, as oil so frequently is, then at least we shall by this means ensure the addition of the results of another deep boring to our knowledge of sub-Wealden geology.

Obituary.

MR. FRANK E. BAXANDALL.

WE greatly regret to record the death of Frank E. Baxandall, which took place on Oct. 30 at Cambridge, in his sixty-first year. He was a native of Keighley, and after obtaining his degree of A.R.C.Sc. at the Royal College of Science, London, entered the service of the Solar Physics Committee under Sir Norman Lockyer. The chief part of the work at that time (1888) consisted of the observation of sunspot spectra and their reduction with respect to chemical origin and variation during the sunspot cycle. The great impetus to astrophysical research instituted by Prof. E. C. Pickering at Harvard College Observatory, Mass., resulted in similar instruments being installed at the Solar Physics Observatory, and Baxandall's duties were then extended to take part in subsequent night observations, taking photographs of stellar spectra with the new 6-inch Henry prismatic camera, and also the work of reducing the spectra for inclusion in a comprehensive analysis of the brighter stars which was published in 1892.

Soon after, it was realised that the then existing information concerning the available terrestrial spectra was inadequate for the reduction of the better stellar spectra given with the new equipment, and provision was made for an entirely new series with a large concave grating which had been obtained from Prof. Rowland at Baltimore. From this time, Baxandall's inclination was directed more towards the tabulation and correlation of the celestial and terrestrial spectra, and for some years he was to a large extent responsible for papers published giving the results of the investigations.

After the transference of the observatory and staff to the University of Cambridge in 1913, Baxandall continued this work, making a revision of part of Rowland's Tables with special reference to the elimination of blended lines which had in the past led to important misidentifications of details of spectral types. Quite recently, he was engaged on investigations of the spectra of several variable stars.

When Baxandall attended the Observatory on the day before his death there was no indication of anything abnormal, and his sudden death came as a great surprise to his numerous friends.

C. P. B.

PROF. AUGUST FRIEDRICH HORSTMANN, a pioneer in the field of physical chemistry, whose investigations of the thermodynamics of chemical processes are well known, died recently in Heidelberg at eighty-seven years of age. We are indebted to the *Chemiker-Zeitung* for the following details of his career. Born at Mannheim in 1842, Horstmann studied under Bunsen and Kirchhoff at Heidelberg, where he was appointed extra-ordinary professor in 1872 and honorary professor in 1889. He conducted numerous researches upon dissociation, vapour-pressure, combustion, chemical equilibria, and solutions, but for very many years his active participation in scientific research was prevented by almost complete blindness. His thermodynamical studies of chemical processes were published in Ostwald's "Klassiker der Naturwissenschaft", edited by Prof. van 't Hoff.

WE regret to announce the following deaths:

Sir Graham Balfour, from 1903 until 1926 Director of Education for the County of Staffordshire, who contributed notably to the progress of technical education in Great Britain, on Oct. 26, aged seventy years.

Dr. Thomas Alexander Wemyss Fulton, superintendent of scientific investigations, Fishery Board for Scotland, from 1888 until 1921, on Oct. 7, aged seventy-four years.

Sir Thomas Hungerford Holdich, K.C.M.G., K.C.I.E., president in 1916–18 of the Royal Geographical Society, on Nov. 2, aged eighty-six years.

News and Views.

THE Nobel Prize for medicine for 1929 has been divided between Sir Frederick Gowland Hopkins, professor of biochemistry in the University of Cambridge, and Dr. C. Eijkman, of Utrecht, for their discoveries in connexion with vitamins. Hopkins' work on vitamins is well known: so early as 1906 he realised that animals cannot flourish on pure protein, fat, carbohydrate, salts, and water, in this respect confirming work by Lumin, Stepp, and others. But the importance of these experiments lies in the fact that he emphasised the point that the failure to live might be due to the absence from the diet of certain unknown accessory food factors, since it occurred even although the animals were eating sufficient food of suitable composition to support growth, as was shown when a source of the accessory factors was added to the diet. These experiments were published in 1912, and from this date the real study of the influence of these factors, or vitamins as they are now called, in nutrition may be said to have commenced. Dietary diseases were not unknown at this period, but other explanations for the symptoms were accepted: the importance of Hopkins' work lies in the new orientation which was given to the study of their causes: thus absence of a factor from the diet may result in failure to grow or other symptoms; previously the symptoms had been explained as due to some influence of the incomplete diet, the deleterious effects of which were neutralised by adding the missing substances.

DR. EIJKMAN will be remembered for his pioneer work on beriberi or polyneuritis. He was the first to realise, in 1897, that the disease arose only when decorticated, or polished, rice was the staple article of diet, and not when whole rice was consumed. He was led to this conclusion by noticing that the poultry of the prison in Java at which he was medical officer

showed paralytic symptoms very similar to those of his patients: the fact that the birds were fed on the rice refuse from the prison strongly suggested that the disease had a dietetic origin. But at this time the theory of accessory food factors had not arisen, and he considered that the cortical part of the rice grain neutralised the deleterious effect of a diet containing too much starch. His work, however, provided investigators with a suitable test animal for the anti-neuritic vitamin B, as it is now called, and the relationship between the vitamin and beriberi has been firmly established by many subsequent experiments. Even though this vitamin has now been shown to be constituted of two (or more) factors, the relationship of one to beriberi and the value of the bird as a test object have been again amply confirmed.

ON Nov. 15 occurs the centenary of the death of the French chemist, Louis Nicolas Vanquelin, whose name is associated with the discovery of chromium and beryllium, two of the twenty-eight elements discovered during the eighteenth century. Though less well known than his great contemporaries Guyton de Morveau, Berthollet, Lavoisier, Fourcroy, and Chaptal, Vauquelin attained a distinguished position among French chemists and held many important positions. His principal work, however, was done in his laboratory, where he carried out a very large number of analyses. The discovery of chromium was made in 1797, that of beryllium, formerly called glucinum, in 1798. Vauquelin was the son of a farm labourer in the village of Saint-André-des-Berteaux, where he was born on May 16, 1763, and his boyhood was one of hardship. At the age of fourteen he found employment with a chemist at Rouen, from whence he went to Paris, where, after suffering illness and destitution, he was befriended by a pharmacist named Chéradame, who later on introduced him to Fourcroy, whose assistant, collaborator, and friend Vauquelin became. Altogether, Vauquelin was partly or solely responsible for some three to four hundred scientific papers, mostly devoted to analyses. In a short review of his work, Sir Edward Thorpe said, "He described a method of separating the platinum metals, and worked upon iridium and osmium. He investigated the hyposulphites, cyanates, and malates. He discovered the presence of benzoic acid in the urine of animals; with Robiquet he first isolated asparagin; with Buniva, allantoic acid; and with Bouillon de la Grange, camphoric acid." Vauquelin died in his native district at the Château des Berteaux.

THE Empire Marketing Board has approved a grant to the Royal Botanic Gardens, Kew, for the distribution of tung oil seeds to various parts of the British Empire. A further grant has been made to the Paint and Varnish Research Association for research into the technical properties of the oil. The grants are a result of recommendations made by a tung oil sub-committee elected recently by the Imperial Institute. An article on tung oil production appeared in our issue of Aug. 17, 1929, p. 272. The oil is an essential constituent of certain types of varnish. It was used during the War in special water-resistant varnishes which were needed for aeroplane work. Until recently, the world's wants were almost entirely supplied by China, but, after the War, tung oil production was successfully started in America. Supplies from China are fluctuating and of irregular quality, and are not likely to expand fast enough to meet the increasing demand. Seeds have been distributed by Kew to various Empire countries, and promising trials are now in hand in Kenya, Australia, New Zealand, South Africa, India, Ceylon, Assam, the West Indies, Malaya, Burma, Hong-Kong, Cyprus, Tanganyika, and Palestine. The Empire Marketing Board grant will provide for the further distribution of seed from Kew, and for the purchase of the tung fruits for experiments in Great Britain. The second grant will provide for the appointment of a research assistant who will conduct tests on the technical properties of Empire-grown tung oil, and other problems, such as the best methods of extraction and suggested new uses for the oil. Experiments connected with the use of the residue as a feeding cake will also be undertaken.

ALL friends of the late Sir William Boyd Dawkins—and they are many—will be glad to know that the services to science of this great pioneer in archæological investigation are to be fittingly commemorated. On Oct. 30, Sir Arthur Keith declared open a number of rooms in the Buxton Public Library and Museum which have been set aside for his scientific books and archæological collections. A possible feeling of surprise or even of regret that these collections should not have found a home in Manchester or even London, where they would have been more readily accessible to students, must vanish when the reasons for the late owner's decision are taken into account. As Sir Arthur Keith stated in his address at the opening ceremony, Sir William Boyd Dawkins, after prospecting in every county in England, had come to look upon Derbyshire as the area in Great Britain richest in the remains of prehistoric man. Sir Arthur Keith quoted him as saying only a little more than a year ago that "what has been found already is nothing compared with that which remains to be discovered". In going on to describe Derbyshire as the 'Dordogne' of Britain, and later the meeting place of converging waves of immigrations and cultures, Sir Arthur did little more than pay an implicit tribute to the insight, the scientific imagination, and the penetration in grasping the significance and value of evidence which were characteristic of Sir William Boyd Dawkins' mind right up to the end of his long career. Of these qualities, now enshrined in the memory of lifelong friends such as Sir Arthur Evans and Prof. A. H. Sayce, who spoke after Sir Arthur Keith, an enduring monument for future generations stands in the collections of prehistoric antiquities which they enabled him to bring together.

ON Saturday, Oct. 26, Sir John Ferguson, M.P., opened the Twickenham Museum at York House, for the housing of local material of interest, ancient and modern. The museum is the outcome of many years' work by the Mayor, Mr. C. Carus-Wilson, who, during his investigations of the local gravels, felt the necessity of preserving the rich geological and archæological

material of the district. The Thames gravels of the neighbourhood have yielded a very rich and varied collection of prehistoric remains, in addition to hitherto unsuspected debris from practically every formation of southern England. Extensive remains of Pleistocene animals have been obtained from a pit at Strawberry Hill. The bones were found at the base of the gravels, 17-20 ft. below the surface, in what was apparently a depression in the London Clay. The animals represented belong to both warm and cold faunas. Bison remains are very numerous. From the same depression a large fragment of a Jurassic coral, with a number of chalk nodules, was discovered. Ashford (Middlesex) and Hounslow have also yielded remains of *Elephas Primigenius* and rhinoceros. During various dredging operations in the Thames in 1885–87, large numbers of Palæolithic implements, and remains of animals no longer found in the district, for example, wolf, fox, deer, were obtained. These are being preserved for comparison with other material obtained from a village site near Teddington lock. It would appear, from the great number of flint cores, flakes, and unfinished implements, that there was an extensive flint knapping industry in the Twickenham part of the Thames valley. The implements found consist largely of scrapers, unfinished or broken spear-heads, and burins. Only one arrowhead was found, and that was of white quartzite. The flint used appears in most cases to have been brought from the North Downs, though a few implements have been made from gravel pebbles. Other archæological remains from the district in the museum include picks ; Bronze age and Saxon spear-heads ; coins, and sixteenth and seventeenth century household utensils from the Thames.

In his presidential address to the Institution of Civil Engineers on Nov. 5, Mr. W. W. Grierson, following the practice of former presidents, dealt with the branch of engineering work with which he has been associated and confined his remarks to questions of transport by road, canal, railway, sea, and air. As a railway engineer whose duties include the supervision of canals, he finds it difficult to see that canal transport in general will prove economical in England. Some of the early canals yielded dividends of 100 per cent a year, and the effect of railways was to bring about a great reduction in charges for canal transport. Transport by road to-day is relatively subsidised and the cost to the community not fully recognised. In the future, this consideration may carry weight in the interests of national economical transport and the road vehicle may become to a greater extent a useful feeder to the railways rather than a favoured competitor. As a successor to Brunel, Mr. Grierson referred to some of Brunel's most successful works, mentioning the graceful brick arch bridge at Maidenhead and the bold timber viaducts used in the south-west of England. Some of these timber structures carried ordinary traffic drawn by locomotives weighing up to about 82 tons until quite recently. With regard to railway electrification, while the superiority of electric traction on suburban lines has long been established, Mr. Grierson regards it as doubtful whether it would prove economical for main lines in Great Britain. Statistics of European railways show that electric traction is adopted on main lines largely where water power is available and where coal is scarce; and where steep gradients favour the electric locomotive.

In the *Quarterly Transactions of the British College of Psychic Science* for October appears a note by the editor, Mr. Stanley de Brath, who deals with the article published in NATURE on Feb. 9, 1929, under the title of "Modern Witchcraft". The author, when referring to the plea for a comprehensive and adequate scientific examination of the facts, regards this investigation as already made, and in support of his assertion points out the inquiries of such observers as Sir William Crookes, Dr. A. R. Wallace, Prof. Hyslop, and Dr. Geley. The article illustrates in a somewhat striking manner the misunderstanding which exists in the mind of the public as to the nature of scientific inquiry and the relative value of the theories deduced thereby. Mr. de Brath's list of authorities signifies but little. Scientific men have, unfortunately, often been persuaded of the reality of things which we now know were but delusions. The history of the famous *N*-rays aptly illustrates this point. Moreover, the selection of the names is not altogether happy. Sir William Crookes's investigations of the medium Florence Cook are recorded nowhere with that attention to detail which scientific scrutiny demands. The credulity of A. R. Wallace also regarding spiritualistic phenomena is known to everyone who is capable of interpreting facts. Similarly the experiments of the late Dr. Geley in the Institut Métapsychique International were not such as inspire the confidence of scientific men in other fields of work.

The whole position regarding investigation of alleged supernormal phenomena is one which it would be well for scientific inquirers to understand. It would appear obvious that the first essential in investigating a medium for the so-called physical manifestations is that measure of control which will effectually prevent the production of those manifestations by normal means. But the senses are hindered in almost every possible way and the investigator reduced to a powerless spectator at a performance which is really a burlesque travesty of scientific experiment. On the other hand, the serious visitor may refuse to accept the 'conditions': he may object to having his senses stifled and he may demand a few of those reasonable precautions which seem to him necessary. In fact, he will refuse to take the part of a mere looker-on and will ask to be allowed to participate in practical experiment. In this case it will usually be found that his presence is undesirable or that his unsympathetic vibrations disturb the phenomena; and the natural result is that he will not be asked again to attend. The cause of 'psychic science' will not be furthered by such methods. Can it be that it is only through following these conditions that 'supernormal' phenomena become apparent ?

IN our issue of Aug. 3, 1929, mention was made of a series of articles published last year in the *Times of India* by Prof. John Maclean, of Wilson College, Bombay. In those articles he advocated contact with reality in the teaching of mathematics on the ground partly of the direct usefulness of such mathematics, but more especially because of its value from the point of view of general education. In a further series of eight articles published this summer in the same journal, Prof. Maclean discusses by way of example the application of mathematics in a number of walks of life, in literature, history, agriculture, medicine, physics, chemistry, and the increasing mathematical equipment that is now required of the economist. In many cases he finds that a device is used in one walk of life but is unknown in other walks, although it would also be of great use in them, and shows the advantage that all would gain by the pooling of this mathematical knowledge. He finds in one profession some elegant and enlightening manner of exhibiting a set of statistics, while other professions know nothing of this, and exhibit their statistics in a clumsy and uninforming way. He finds also that a profession which furnishes one elegant piece of treatment may be clumsy in other cases, in which another profession is more elegant. Prof. Maclean makes a good case for the scrapping of irrelevant mathematical matter and the substitution of a suitable treatment of statistics. The scheme is already at work with very good results in the first year course of the University of Bombay.

SEVERAL valuable papers were read to the Association of Public Lighting Engineers held at Bournemouth in September last. Some of these papers are reproduced in the *Illuminating Engineer* for October. The president, S. B. Langlands, the public lighting engineer to the city of Glasgow, pointed out that the duties of the street lighting engineer were increasing daily. In Glasgow the care of police signals, traffic signs, and street clocks was part of his duty. In addition, street name tablets and street numbers would probably soon be illuminated. The reflective power of the road was discussed with the city engineer and the visibility of policemen with the chief constable. In Glasgow the policy of establishing a lighting department had been a great success. Some cities, like Glasgow and Leeds, spend more than four shillings per head of the population per annum and some, like Sheffield and Birmingham, only spend about half this amount. The rateable value of Glasgow exceeds eleven pounds per head, whilst in Sheffield it is less than five pounds. There is need, therefore, of some uniform assessment procedure. In Great Britain all the expenditure for public lighting is met by assessments, but in America the costs are often partly defrayed by contributions from business houses which benefit directly from the improved illumination. The gas industry cannot afford to ignore the question of gas mantles, and it would be in the true interests of the electrical industry to reduce appreciably the price of electric lamps. For public lighting the cost of electricity in Glasgow is $1\frac{1}{4}d.$ per unit, but the electricity commissioners hope that this will soon be lowered to $\frac{1}{2}d.$ per unit. In America it is the standard practice for progressive cities to spend at least two dollars (about 8*s.* 4*d.*) per head per annum for street lighting service.

THE popular notion that many animals possess a language of their own, through which they communicate to their own kind their wishes, thoughts, and feelings, has received a certain amount of support from experiments having a sort of scientific flavour. But a critical examination of the facts throws a different light upon the problem. In an article on "Animal Language in its Relation to that of Man" (*Biol. Proc. Cambridge Phil. Soc.*, vol. 4, July 1929) J. A. Bierens de Haan analyses the alleged evidences of animal language and decides against the believers. He concludes that animal language in all its essentials is inferior to that of man. It is rarely vocal, scarcely ever articulate, and has no words in the sense of sounds bearing a conventional meaning. The sounds are uttered unintentionally, show no capacity for development, and do not indicate anything, though they express feelings and emotions. Real creative language, the faculty of combining words into phrases, is beyond the faculties of the animal mind. Even in contact with man, animal language in its highest form remains the language of an animal. It seems that an unbridgeable gulf here separates man from the animals. Nevertheless, the subject has seldom been treated with the serious study which it deserves, and the author commends it to biologists and animal psychologists.

THE announcement of the intention of the Southern Railway Co. to electrify the main line between London and Brighton marks an epoch in the development of electric traction in Great Britain. It was made possible by the Budget of 1929, in which the Government duty on passenger fares was remitted on condition that the money was expended on improving the railway systems and bringing them up-to-date. In a paper in the *Electrical Review* for Nov. 1, A. T. Dover gives interesting details of the proposed conversion of the Brighton line from steam to electric traction. The distance of 51 miles is relatively short, the route is level, and the passenger traffic is exceptionally heavy. The fastest trains take an hour and the ordinary expresses 15-30 minutes longer. The train weights are 200-350 tons, and quadruple tracks are provided over practically the whole route. With electric traction it would be quite possible for the 'limited' trains to do the journey in 45 minutes and for ordinary expresses to do it in about an hour. This improved service with additional trains will doubtless attract the additional traffic which the railways need. The direct current system which is the standard for Great Britain will be employed. The existing 650-volt conductor rail system will be used. The main line trains will probably be hauled by electric locomotives similar to those used on the Continent, which give an output up to 1000 horse-power per axle. Speed control is now very much more flexible than in the early days of electric traction. Fifteen economical running speeds are possible by combining series-parallel control and control by the field magnets. The shelving of the

original scheme owing to the War, therefore, has not been all loss.

AN important group of new radio stations was opened last month at Aranjuez, near Madrid. Most of the necessary apparatus came from England, and much of it was erected by British workmen. The stations were designed by Marconi's Wireless Telegraph Co., Ltd. This group of radio stations expands the range of Spanish external communications. Madrid is now placed in direct radio communication with both North and South America. By means of the Marconi short wave beam installation at Aranjuez, a regular commercial telephone service between Spain and the Argentine Republic is available in addition to high-speed beam telegraph services. The stations belong to the Transradio Espanolo, and special receivers for them have been constructed by the Marconi engineers.

MORE than forty nations have now accepted the Government's invitation to take part in the World Poultry Congress to be held at the Crystal Palace on July 22–30, 1930. Of these, no fewer than twenty-three have established national committees for the purpose of organising their representation at the Congress and the accompanying exhibition. It is already apparent that the forthcoming meeting will exceed in size and effectiveness any previous exhibition of a similar character that has yet been held. The decision to extend the scope of the exhibits beyond poultry alone should add to variety and interest. It is proposed to show varieties of rabbits' fur bred commercially in Great Britain along with a range of garments made from home-produced fur, and the Ministry of Agriculture and Fisheries has invited the co-operation of leading horticulturists who will be responsible for massed displays of flowers and plants throughout the exhibition.

THE Report of the Ordnance Survey for the year ending Mar. 31, 1929, records a steady progress in the revision of the maps of Great Britain. About half the sheets of the 25-inch and 6-inch maps of England and Wales, and most of the sheets of southern Scotland, have now been revised. Road revision for 110 sheets of the Popular edition of England and Wales subsequent to the third revision has now been carried out. In the third revision of the Popular edition of Scotland 49 sheets have been published and the field-work for the other sheets, including the Hebrides and Shetland, is finished. Work on the fourth revision of the 1-inch map of England and Wales was begun around Plymouth. Corresponding revisions are under way with the smaller scales. Physical maps of England and Wales and of Scotland, a magnetic map of England and Wales, and a second edition of the map of Roman Britain were published. A map of England and Wales during the seventeenth century is nearly ready. It is satisfactory to note that the sale of all Ordnance maps, and especially the 1-inch Popular map, shows an improvement.

AN exhibition of the historical scientific apparatus belonging to the Royal Institution has been arranged at the Science Museum, South Kensington, and will be opened by Sir William Bragg on Friday, Nov. 15, at 4.30 P.M.

THE fifteenth in the series of public lectures on physics in industry, organised by the Institute of Physics, will be delivered by Dr. C. H. Lander, Director of Fuel Research, Department of Scientific and Industrial Research, who will take as his subject "Physics in Relation to the Utilisation of Fuel". The lecture will be given on Wednesday, Nov. 27, at 5.30 P.M., in the rooms of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

COLOURED drawings of the remarkable mosaics, Jewish and Christian, from the synagogue and churches recently excavated at Jerash in Trans-Jordan, by the British School of Archæology in Jerusalem, and Yale University, are on exhibition, by the courtesy of the Palestine Exploration Fund, in its rooms at 2 Hinde Street, W.1 (off Manchester Square), until Saturday, Nov. 16. The subjects of the mosaics include representations of the deluge, views of Alexandria and Memphis, Nile-side scenery, portraits of benefactors and functionaries, studies of animals and birds, inscriptions in Greek and Hebrew, as well as richly designed borders imitating carpets and other textiles.

MESSRS. A. Gallenkamp and Co., Ltd., have issued list No. 75 E of the small electric furnaces which are rapidly becoming popular in the laboratories of colleges and factories on account of the ease with which a constant temperature may be maintained. The firm claims to have been the first makers of small electric furnaces in Great Britain, and the new models have been designed to reduce the cost of heating to reasonable limits. Although the nichrome alloy of which the heating elements are made will withstand temperatures well above 1000° C., this temperature is the maximum for economical working, and the coils are designed to last for more than 1000 hours. At lower temperatures they will last very much longer. They can be adapted to direct or alternating currents at pressures up to 250 volts, and renewal of the coils is easily and cheaply effected. The list includes tube furnaces for use in estimating carbon in steels, furnaces for organic combustions, muffle and crucible furnaces and pyrometers. For higher temperatures silit-tube furnaces are made which are fitted with special non-metallic heating elements resembling silicon carbide.

THE latest catalogue (No. 334) of Messrs. W. Heffer and Sons, Ltd., Petty Cury, Cambridge, should be of interest to librarians and others on the look-out for sets or long runs of scientific periodicals and transactions of learned and scientific societies, and for standard scientific books. Nearly 1800 works are listed. The list is obtainable free on application to the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer for mining courses under the Derbyshire Education Committee—The Director of Education, County Education Office, Derby (Nov. 16). A medical officer in charge of radium at the General Infirmary, Leeds—The General Manager, General Infirmary, Leeds (Nov. 18). An assistant in mathematics in Queen's University, Belfast—The Secretary,

Queen's University, Belfast (Nov. 20). A senior assistant pathologist to the Pathological, Bacteriological, and Clinical Research Department of the Royal Sussex County Hospital—The Secretary-Superintendent, Royal Sussex County Hospital, Brighton (Nov. 21). Three junior research assistants (a biochemist, a histologist, and a physiologist) in the Animal Genetics department, the University, Edinburgh—The Secretary, The University, Edinburgh (Nov. 22). An assistant lecturer in municipal and sanitary engineering at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (Nov. 30). A lecturer in economics and statistics in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, W.C.2 (Dec. 18). A test assistant at the Royal Aircraft Establishment to assist in experimental metallurgical work—A, 385, The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A junior technical officer in the Admiralty Technical Pool—The Secretary of the Admiralty (C. E. Branch), Whitehall, London, S.W.1. A geologist on the Geological Survey Staff, Nigeria.—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An assistant master to teach woodwork, chiefly in the Maidstone Junior Technical School—The Principal, Technical Institute, Maidstone. A junior chemist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Director, Paint Research Station, Waldegrave Road, Teddington. A demonstrator in agricultural botany in the University of Reading—The Registrar, The University, Reading. Metallurgical research investigators; also a science graduate for the critical examination and abstraction of technical literature in connexion with technical reports, etc., each under the British Non-Ferrous Metals Research Association—The Secretary, British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham.

Our Astronomical Column.

Recent Solar Activity.—A large, naked-eye sunspot of composite structure was a conspicuous object to those persons who watched the phases of the partial solar eclipse on Nov. 1. The spot crossed the sun's central meridian on Oct. 31·0, and there were disturbed magnetic conditions recorded at Abinger on Nov. 1–4. For some hours after 15h on Nov. 3 the magnetic disturbance reached 'storm' intensity, the range in declination being about 36′. It may be noted that disturbed magnetic conditions occurred on Oct. 7–10, that is, about a solar rotation earlier. Another group of sunspots possibly associated with the recent magnetic storm was a stream which, growing rapidly from small spots on Oct. 30, covered an area of 900 millionths of the sun's hemisphere on Nov. 3. Mr. Newbegin at Worthing observed this group with a spectroscope on Nov. 3 and saw that it was unusually active. There were reversals of lines of sodium and magnesium and a brilliant reversal of the *c*-line of hydrogen over the centre of the group. A third spot to be noted came into view round the east limb on Nov. 3 and was accompanied by a metallic prominence. This spot will probably be visible to the naked eye and is the return of one designated No. 10 in the list of spots given on p. 631 of NATURE, Oct. 19. The following table continues the tabulation of large sunspots.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
12	Oct. 24–Nov. 6	Oct. 31·0	10° N.	800
13	Oct. 30–Nov. 9	Nov. 3·7	14° N.	900
14	Nov. 3–Nov. 15	Nov. 9·6	10° S.	500

(Areas in millionths of sun's hemisphere.)

Interesting New Minor Planet.—The discovery of new planets is going on steadily at the rate of more than a hundred per annum. From time to time a discovery of more than usual interest is announced. A planet the provisional designation of which is 1929*SA* was found photographically by Prof. M. Wolf at Königstuhl on Sept. 26. It attracted special notice from the length of its trail, which indicated that it was moving northwards at the remarkable rate of half a degree per day. *Beob. Zirk.*, No. 38, announces that Dr. G. Stracke of the Berlin Rechen-Institut has computed elliptical elements from observations on Sept. 26, 28, and Oct. 7. He finds that the period is 4·375 years, the eccentricity 0·4648, and the perihelion distance 1·432, so that the planet comes inside the orbit of Mars. The orbit is of similar type to those of Aethra and Ganymede. The aphelion distance is 3·918, and the inclination 14·9°. The planet was of magnitude 13 when discovered, it being then not far from perihelion. It will probably be too faint to observe when near aphelion.

The same number of *Beob. Zirk.* announces that M. Gussow, of Babelsberg Observatory, has found that the spectroscopic double star Boss 6046, the magnitude of which is 5·13 and its spectral type *B*3, is an eclipsing variable of Algol type. The light-range is 0·17 mag., and the period of variation 6·067 days; the latter was deduced from the spectroscopic orbit.

The Orbit of γ Centauri.—This is one of the binaries the components of which are nearly equal in magnitude, and approach each other very closely at periastron, so that there is danger of confusing the components when they again become separately visible. Such binaries have generally two possible orbits, one with a short period, high eccentricity, and small inclination, the other with a long period, low eccentricity, and high inclination.

Union Observ. Circ., No. 78, contains a discussion of its orbit by W. H. van den Bos. Dawson had given in *Ast. Jour.* 765, an orbit of the second of the above types (period 200 years, eccentricity 0·3) based on observations from 1852 to 1920. Observations from 1920 to 1928 led van den Bos to conclude that it has a first-type orbit with period 80·4 years, eccentricity 0·86. See had already in 1895 published elements not far from the new ones, but the additional 34 years have greatly strengthened the determination. The components are now too near each other for easy separation, but there is an appeal for spectroscopic observations, which will both check the new orbit and also afford a determination of the star's parallax. This has been estimated as 0·027″ using Eddington's curve connecting mass with absolute magnitude. The mass of each star is estimated as three times that of the sun, absolute magnitude of each 0·0 bolometric, 0·3 visual. A larger parallax would give smaller masses. The relative radial velocity at periastron (1930·2) would be 38 km./sec. with the above parallax. The apparent separation of the stars is a minimum, 0·09″, at the end of 1930, increasing to 0·42″ three years later.

Research Items.

Azande Oracles.—An extensive study of the oracle magic of the Azande peoples of the Anglo-Egyptian Sudan by Mr. E. E. Evans-Pritchard is published in vol. 11 of *Sudan Notes and Records*. Of all the methods of divination employed by the Azande, one, *benge*, stands apart. *Benge* is a red powder obtained from a creeper which, when mixed with water, forms a paste. This paste is administered to chickens, and causes spasms which may or may not end in death, and, according to the results, determining the answer to questions which have been put to the *benge* in the chicken's stomach. The creeper does not grow in the Azande country, but to the south of the Welle and some hundreds of miles away. It is obtained by men who on the journey must observe the requisite food and sex taboos. Any man, but not the women, may consult the *benge* oracle, but when the chief wishes to consult *benge*, it is administered by regular officiators of the oracle of whom the chief has two or three, and each of whom acts for a month at a time, observing the necessary taboos. When any but a chief wishes to consult the oracle, *benge* may be administered by anyone, even the man himself, or a friend, who has observed the taboos. Two consultations of the oracle are necessary on every occasion, and in the second the result must be the reverse of that of the first. Thus if the death of the fowl gives an affirmative answer on the first occasion, on the second it must not die. The method of consultation is for the officiator to hold the fowl between his feet and by means of a grass brush to put down the throat of the fowl one, two, or three doses of the poison; the questioner, sitting in front of him, puts the question to *benge* in the stomach of the fowl. When the case has been put fully before it, the chicken is held up on the hand of the officiator, when the case is again put to it more vigorously, while it shows the effects of the poison. If it is to die, death supervenes in spasms, and it is thrown on the grass. Of the oracles *benge* is the most important. It is used judicially and before all serious undertakings such as marriage. Its verdicts are socially and ritually binding.

Carbohydrate Transformation in the Animal Organism.—In the *Rendiconti* of the Royal Academy of Sciences of the Institute of Bologna for 1928, just received, Prof. Pietro Albertoni gives a summary of experiments made to obtain information as to where, in the animal organism, the transformation of carbohydrates takes place. With a rabbit which has been fasting for 20 hours, moderate quantities (20-25 grams) of glucose do not pass into the circulation, but are completely retained by the liver, the respiratory changes in the muscles being thus unaffected. In general, ingested glucose passes to the various tissues in the proportions determined by the conditions of its absorption and distribution in the organism, its metabolism being more active in the liver than in the muscles. As regards the respiration of the tissues, the mode of behaviour of any substance varies according as it is simply placed in contact with the tissue or reaches this by means of ingestion.

Behaviour of *Caudina*.—Mr. Toshihiko Zamanouchi, in continuing his work on *Caudina chilensis*, has studied its behaviour in a variety of ways (*Science Reports of the Tohôku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 4, No. 1, fasc. 1, February 1929). This holothurian burrows in sand except for the tip of its tail, which is directed upwards, just on the surface of the sea bottom. Here it makes respiratory pulsations day and night, ejecting at intervals a large amount of sand with water. If dragged out of its burrow it will bury itself again by means of the tentacles and body muscles, the heavier the animal the slower the burrowing. In its natural position in the sand the body is soft and flexible with muscles relaxed; if taken out it will harden itself with greatly contracted muscles. If placed on a glass plate movements similar to burrowing movements are made. The whole body is very sensitive to mechanical stimuli, the head part most, then the tail, lastly the mid-trunk. The tail end is negatively geotropic even when severed, the front end positively geotropic. The behaviour of *Caudina* is studied with regard to various chemical stimuli, the entire body surface being very sensitive. Stimulations were made by local applications of the solutions on the body surface. The anterior part of the trunk is the most sensitive, and young animals react more actively than older individuals.

Gorgonacea from Panama.—Prof. Sydney J. Hickson's report on "The Gorgonacea of Panama Bay together with a description of one species from the Galapagos Islands and one from Trinidad" (Papers from Dr. Th. Mortensen's Pacific Expedition, 1914–16. *Vidensk. Medd. fra Dansk naturh. Foren.*, Bd. 85, 1928) contains much that is new. It describes a collection made by Dr. Cyril Crossland during the voyage of the S.Y. *St. George* in the Panama region and the islands of the Eastern Pacific Ocean, together with Dr. Mortensen's collection from his Pacific Expedition. The region lies within the 100 fathom line, and is characterised by the muddiness of the sea, the extensive muddy bottom and few sea-weeds. Nearly all the Alcyonaria present belong to the Gorgonacea and this group is present in profusion. So rich are these muddy waters in species and varieties that systematic work is very difficult. Prof. Hickson finds that the species of *Alcyonaria* found in Panama Bay are distinct from any that have been described from the western tropical Atlantic, but that there is a certain parallelism between the species in the two regions although they belong to different genera, those from the Pacific side being apparently more primitive. These facts are in the author's opinion consistent with the view that there was continuity between the two oceans in early Miocene times. The specimens were well preserved and a valuable record has been made of the state of the gonads in the months of the year in which they were collected. Two new species of *Euplexaura*, one of *Thesea*, one of *Muricea*, and four of *Leptogorgia* are described, and the memoir is illustrated by one coloured and two uncoloured plates besides various text figures.

South African Branchiopoda.—The exceptional richness of the fauna of South Africa in Branchiopod Crustacea is shown by Dr. Barnard's recent revision (*Ann. S. African Mus.*, **19**, p. 181, 1929), in which he describes 49 species. Dr. Barnard has already added much to our knowledge of these interesting Crustacea, but 13 of those mentioned are described here for the first time, and, as he points out, there is still much unexplored territory, so that the list is probably by no means complete. This revision is a valuable contribution to the systematics of the group, since the abundant material, examined on the spot, has enabled the author to estimate the range of variability of the species. His remarks on the genus *Apus* are most valuable. The limits between species are very ill-defined, and the comments on the value of the specific

characters commonly used are based on extensive experience and should be helpful in reducing the genus to order. Of the genus *Lepidurus* no species now lives in South Africa, but one is recorded from the Upper Triassic Stormberg beds. Since *Lepidurus*, unlike *Apus*, usually inhabits clear permanent pools, this fossil species is regarded as evidence of a change of climate since the deposition of the Stormberg series. On the other hand, permanent pools do exist, and provide a home for *Cyclestheria hislopi*, which is not definitely known to produce resting eggs, and there does not therefore seem to be convincing reason for the disappearance of *Lepidurus*.

Insects of Samoa.—The British Museum (Natural History) has issued further fascicules of the "Insects of Samoa", a monographic work describing the insects and other terrestrial arthropods of the Samoan Islands. Previous instalments of this important work have already been noticed in our columns and the parts before us deal respectively with the Myriapoda by Mr. C. Attems, the Araneida by Dr. L. Berland, the coleopterous families Platypodidæ and Scolytidæ by Dr. C. F. C. Beeson, and with a number of different families of Diptera by various recognised specialists. Since the commencement of this monograph in 1927, twenty fascicules have appeared, and when completed the whole work will form an authoritative synopsis of the arthropod land-fauna of the islands in question.

Soils and Fruit of Wisbech.—A survey of the soils and fruit of the Wisbech area, prepared by Messrs. Wright and Ward, of the School of Agriculture, Cambridge, has been issued by the Ministry of Agriculture (Research Monograph, No. 6) as the first of a series of similar publications. The district under consideration occupies an area of thirty-six square miles on the borders of Norfolk and Cambridgeshire. Generally speaking, the geological formation may be classed as silt, though five distinct soil types are recognised. The properties and distribution of these soils are fully described from an essentially practical point of view in the first part of the monograph. Information is also supplied concerning the water in the district, and the methods employed in sampling and analysing the soil. A short history of the fruit industry and an account of present day cultural methods in which pruning, manuring, and spraying are included comprise the second part. In the third part the relationship between soil and fruit and the kind of fruit grown on the various types of soil are described. Each of the main crops such as apples, plums, pears, cherries, gooseberries, raspberries, and strawberries is dealt with in turn, the effect of soil on the growth, liability to disease, size, and keeping qualities of the fruit being among the points discussed. Actual figures in support of the conclusions drawn, full details of the soil analyses, a rainfall table, and a short list of references are given in an appendix. In addition, three detachable large scale maps are supplied showing respectively the areas occupied by the various soil types, and the districts in which tree fruits and strawberries are grown.

Climate and Agriculture in Russia.—In Russia the vast expanse of the plains and the absence of mountains provide a unique example of the regular distribution of vegetation, soils, agriculture, and population in climatic zones. In *Berichte über Landwirtschaft* (Neue Folge), vol. 9 (1929), pp. 478-527, published by the German Ministry of Nutrition and Agriculture, Prof. W. P. von Poletika, formerly of the University of Leningrad, has given an analysis of the geographical distribution of types of agriculture in relation to climatic factors. His paper is especially useful as it summarises many papers and data which have not previously been available owing to language difficulties. The production of vegetable matter per unit area is greatest in the central portion of the broad-leaved forest zone and to the north falls off regularly through conifer forest to tundra with decreasing temperature, and to the south through steppe to desert with decreasing rainfall. At present the northern part of the steppe region is the most highly developed agricultural region, but further intensification, especially to the south, will be limited by the recurrence of summer droughts, at any rate until there is a much better control of soil water by improved methods of cultivation. The moderate climate of the oak climatic zone offers the greatest opportunity for intensification of agriculture. In the dry regions of the Transcaucasus and Turkestan the development of irrigation is made difficult by the prevalence of malaria, the salinity of the soils, and the low cultural level of the inhabitants. The whole discussion is pessimistic and emphasises the serious climatic obstacles to development. It explains the paradox that in spite of its low population density Russia suffers from an acute land shortage. Whilst in population density Russia is comparable with extensively farmed countries such as the Argentine, Canada, and U.S.A., the amount of waste land is so great that the area of cultivated land per head is comparable with that of France or Italy. The future prosperity of Russia must therefore depend not merely on an intensification of the agriculture in the favoured areas, but above all on the exploitation of its mineral wealth and the building up of its industries.

Ordovician Ostracoda from Tennessee.—In studying a collection of Ostracoda from the Trenton Limestone of Nashville, Tennessee (*Amer. Jour. Sci.*, vol. 16), S. R. Kirk found that the majority were referable to *Isochilina ampla*, Ulrich, but that that species ought more properly to be placed in the genus *Leperditia*, the members of which can, however, be graded into *Isochilina*. To avoid creating a new genus to accommodate border-line forms, the author decided to broaden the definition of *Leperditia* so as to include all forms of appreciable overlap and thus to retain the present genera. The representatives of two other genera are described: *Ctenobolina* and *Drepanella*, a new species of which, *D. progressa*, shows features in common with both *Drepanella* and *Klædenia*, thus favouring the idea of the evolution of the latter genus out of the former.

Lower Carboniferous Fossils in Arkansas.—"The Fauna of the Middle Boone, near Batesville, Arkansas", forms the subject of a paper by G. H. Girty (U.S. Geol. Survey, *Professional Paper* 154-B). The introduction gives some geological information concerning the deposits. In a few points the fauna of the Middle Boone shows affinities with that of the Upper Boone from the same area and with that of the 'Spring Creek Limestone', which may be treated as a unit therewith. Substantial conclusion as to the relations of this fauna to the typical Mississippian faunas of Iowa and Missouri is at present out of the question. The only safe statement at present seems to be that this fauna from Batesville is not typical Boone, but more related to the earlier ones of Burlington and Keokuk age. So far as at present known, the fauna here described comprises forty-five more or less provisional species or varieties. It essentially consists of brachiopods, among which the Spirifers are the most abundant, followed by the Producti. The description of the species shows that a few are considered to be new, and four plates of figures of the more interesting forms are appended.

Tango (Japan) Earthquake of Mar. 7, 1927.—This earthquake, the most destructive in Japan since the great Kwanto earthquake of 1923, continues to be the subject of important studies by Japanese seismologists. A new series of precise levellings was made across the central area from April to June 1927, a second series from June to July 1927, and a third from March to April 1928. Mr. C. Tsuboi, in an interesting paper (*Earthquake Res. Inst. Bull.*, vol. 6, pp. 71-83; 1929), interprets the changes of level that occurred in the intervals between the series. For different sections of the district surveyed, he gives diagrams on which the displacements of the benchmarks are plotted. These points lie on segments of straight lines, the ends of which for the two intervals lie on the same abscissæ. These facts suggest that the ground of the central district is made up of a number of separate blocks, each of which was able to move comparatively easily after the great earthquake and moved practically as a whole. In some blocks, the tilting occurred in the same direction in both intervals, but, in a few, in opposite directions. The boundaries of the blocks coincide very closely with the faults, many of them of recent date, that have been traced during the geological surveys of the district made since the earthquake. Mr. N. Nasu also contributes to the same journal two important reports on the numerous after-shocks of the earthquake (vol. 6, pp. 245-331; 1929; and vol. 7, pp. 133-153; 1929). He finds that most of the shocks originated at depths of less than 30 km., and that the most active zones are those lying to the west of the Gomura fault and to the south of the Yamada fault (see NATURE, vol. 122, p. 587; Oct. 13, 1928). The sensible shocks were connected with the growth of these and other faults, the insensible shocks with the formation of series of parallel cracks due to the shearing stresses applied to the blocks. From the records of clinographs installed in the district, Prof. Ishimoto found that the earth showed a characteristic tilting for several days before a moderately strong after-shock.

Detrital Asphalt.—"The presence of considerable *detrital asphalt* in the Sinbad limestone member of the Moenkopi formation" is an observation made in the otherwise dull memoir on some Utah gas and oil prospects by Mr. J. Gilluly (*Bulletin* 806-C, 1929, United States Geological Survey), and is clearly one inviting description and explanation, which, however, the author does not see fit to give. Again, he speaks of "the *sedimentary asphalt* of the Shinarump conglomerate", in both cases the italics being ours. Both formations mentioned are of Triassic age and have apparently been laid down in shallow water. Regarding the first, "oolite-like grains of asphalt" occur throughout the particular bed; the presumption here is that bitumen pellets, sufficiently hard to withstand redeposition from some pre-existing bituminous rocks, have found their way into a basin in which sandy limestone was accumulating, have further withstood the process of consolidation, and finally the test of a long period of geological time. In connexion with the other occurrence of *sedimentary asphalt*, the author argues that this is evidence of the existence of petroliferous rocks of pre-Shinarump age. We wonder whether the use of the words 'detrital' and 'sedimentary' in these cases is really valid, and, if so, why the author did not seize the opportunity to describe fully two such interesting and almost unique deposits. Derived asphalt from bituminous rocks which contribute to contemporary deposits, for example, alluvium, gravel, shore-sand, etc., is well known, but an actual case of *detrital* asphalt, if this indeed is the true mode of origin, is surely something quite new, at least in the sense understood in this description, and especially in association with a limestone.

The Katharometer in Gas Analysis.—The katharometer, manufactured by the Cambridge Instrument Company, Ltd., is now extensively employed for carrying out gas analyses in industrial and other processes. Essentially the instrument consists of two heated fine wire spirals constituting two arms of a balanced Wheatstone bridge. If the respective spirals are now surrounded by gases of different thermal conductivity, then the initial balanced condition of the bridge will be upset to an extent dependent upon the difference of thermal conductivity of the two gases—one of which is a standard gas—and the resulting galvanometer deflection will serve to indicate the extent to which a certain constituent is present in the other gas. The method is simple, accurate, quick, is capable of detecting very minute changes in gas composition, and the apparatus has a low time lag, and has for some time been employed for the analysis of flue gases. More recently the apparatus has been used to test the purity of hydrogen and nitrogen and to control the mixture of these gases in nitrogen fixation plants. It is employed to measure accurately the purity of oxygen derived from liquid air. The percentage of helium, neon, or argon present in oxygen or nitrogen is readily indicated. In chemical industry the katharometer has found application in determining sulphur dioxide and organic vapours, for example, acetone, carbon bisulphide. The device is also used in the determination of oxygen in feed water, for determining carbon monoxide, in the analysis of gases used for filling balloon envelopes, for determining carbon dioxide in fruit stores, for determination of humidity, and in physiological determinations connected with respiration. Particulars of these and other applications are contained in List No. 144 issued by the Cambridge Instrument Company, Limited.

The Positive Column in Arcs.—The fresh conceptions introduced by Dr. Langmuir into discharge tube theory have led to such conspicuous advances within the last six years that instances in which they are inadequate are liable to be overlooked. These are of course significant in themselves, and the main outstanding one has been examined by Dr. Langmuir and Mr. L. Tonks in a paper on the general theory of the plasma—essentially the positive column—of an arc, in the second September issue of the *Physical Review*. The difficulty in question was that discrepancies arose from the obvious assumption that the positive ions, like the electrons and unionised gas-molecules, possessed random velocities and an equivalent temperature. This is now replaced by the assumption that each ion starts from rest, and merely acquires energy in the electric fields in the tube; for long free paths, the motion of the ions is thus more ordered than in the older picture. Mathematical elaboration of this, with approximations appropriate to the physical problems, then leads to solutions for the spatial distribution of potential in some important cases, and by the further development and incorporation of some allied ideas, a set of equations is arrived at which, apart from incomplete knowledge of some factors of an atomic nature, determines completely the conditions in the positive column. A final note by the authors touches upon the stability of arcs, and here, without yet obtaining a solution, they indicate the lines upon which one will probably be reached. The same number of the *Physical Review* also contains a paper by E. Z. Stowell and H. E. Redeker, on the rôle of hydrogen in the oscillating arc.

Structural Steels of High Elastic Limit.

THE demand for stronger, but still relatively cheap, steels in shipbuilding, and in bridge and boiler construction, etc., gives considerable importance to a paper on the subject recently presented by J. A. Jones to the Iron and Steel Institute.

It is well known that it is possible to increase the elastic limit and tensile strength of the steel by an increase in the carbon content, but a comparison of steels with identical maximum strengths shows that this method of securing high-tensile properties is much less satisfactory than by increasing the amount of manganese present. A higher carbon steel, with a given maximum strength, has a lower elastic limit, yield point, and elongation, and a much lower impact value than a lower carbon steel of similar tenacity obtained by the addition of more manganese. Its fatigue range is also lower than that of a low-carbon high-manganese steel, and it is, further, much more affected by slight departure from the most suitable conditions of normalising.

The improvement in the properties of these steels by the addition of manganese is very marked, but the amount present must be limited to a figure which varies with the carbon content. With 0·2 per cent of carbon, a suitable maximum percentage of manganese is 1·8 per cent, which falls to 1·5 per cent when the carbon content is increased to 0·35 per cent. These figures apply particularly to sections $\frac{3}{4}$ in. thick; the limits of manganese content being rather lower for thinner sections. A small amount of nickel increases the ductility of low carbon steels, but at least 3 per cent of this element is required to produce a steel belonging to the high elastic limit class, and it is suggested that the use of a small amount of chromium at a lower cost would appear to be more promising.

The influence of silicon in raising the elastic limit and tensile strength of mild steel has been known for a long time, and much interest has been shown in Germany lately in a steel containing about 0·1 per cent of carbon, 0·5 to 1·5 per cent of manganese, and 0·6 to 1·5 per cent of silicon. The tensile strength of this material is from 30 to 35 tons per square inch, but with a higher carbon content, increased tenacity may be obtained. The test results given show clearly that silicon raises the fatigue range and the ratio of the fatigue limit to the tensile strength to a greater extent than does manganese. With a silicon content of 1·5 per cent, however, a marked lowering of the impact figure occurred, and no silicon steel was found with all-round properties superior to those of a plain manganese steel containing 1·5 per cent of that element. Further, the higher silicon steels present certain difficulties in manufacture. The steel pipes deeply, involving a high percentage of discard, higher temperatures are required for annealing and rolling, and greater care must be exercised in reheating, in order to avoid cracks.

Owing to these difficulties in the production of silicon steel on a large scale, a new structural steel is being developed, containing approximately: carbon 0·15 to 0·18, silicon 0·25, manganese 0·8, copper 0·5 to 0·8, and chromium 0·4 per cent. The amount of scrap produced is small, and in spite of the additional cost of the special elements, the steel can be produced more economically, and with more reliability than can the silicon steel. It has a lower tensile strength than the steels considered in Mr. Jones's paper, but an increase in the carbon with an adjustment of the copper and chromium contents might lead to the development of a high quality steel with a high limit of proportionality and good ductility.

On the whole, it is concluded that of the materials examined a steel containing 0·3 per cent of carbon, 1·3 per cent of manganese, and 0·9 per cent of silicon yields the best mechanical properties. Normalised at 860° C., this steel gave the following test results:

Elastic limit	26·8 tons per square inch.
Yield point	29·8 „ „ „ „
Maximum stress	45·6 „ „ „ „
Elongation	30 per cent.
Reduction of area	63 „ „
Brinell hardness	200
Izod impact value	44 ft.-lb.

F. C. T.

Scientific Uses of Gramophone Records.

THIRTY years ago, the possible use of gramophone records in phonological studies was realised and discussed at a meeting of the Vienna Academy of Sciences. Since then, large collections have been formed of records of all the European languages and dialects and of the speech and music of many of the primitive peoples. In archives are preserved at Vienna some 3000 records, at Paris 4000, at Berlin 10,000, and collections of similar size are to be found at important centres in all parts of the world. The first use of gramophone records in the exact sciences was in a rather premature attempt to analyse the physical nature of vowel sounds. Enlarged tracings of the grooves were obtained by a lever system from the slowly rotating record and were assumed to represent the original sounds.

Until quite recently no systematic research had been carried out upon the gramophone, but during the last few years the new electro-mechanical acoustics has been applied and has made possible the preparation of records of special value for many electrical and acoustical laboratory measurements and experiments. The Parlophone Co. has issued a set of three sound test records[1] prepared under the direction of Drs. E. Meyer and H. Salinger, of the Hertz Institute, Düsseldorf. The first record gives on one side when rotated at a speed of 80 revolutions per minute an almost pure sine wave output beginning at a frequency of 6000 and steadily gliding down to 100 Hertz (1 Hertz = 1 vibration per sec.). To overcome the difficulty of the stationary waves set up when such a record is used to obtain acoustical response curves with fixed apparatus in an ordinary room, the other side of the record is prepared to give a 'gliding howling' tone the frequency of which varies about 10 times per second by ± 50 cycles, whilst the mean frequency decreases as before steadily from 6000 to 150 cycles. The system of nodes and antinodes in the room is, therefore, continually shifting. The other records of howling tones give a frequency band which is traversed about 10 times per second, whilst the mean frequency remains constant at a selected one of eight possible values.

The Gramophone Co. (H.M.V.) also issues a list of fifteen double-sided 12-in. constant frequency records, which, when rotated at a speed of 78 revolutions per minute, are capable of giving any one of 100 different frequencies of 50 seconds duration, of which the lowest is 25·5 and the highest 8460 cycles. Many possible uses of these special records are indicated in the technical press, the Parlophone Co.'s leaflet,

[1] Sound Test Records. Three 12-in. d.s. with album and instructions. Obtainable only from Parlophone Co., Ltd., 85 City Road, E.C.1. 42s. net.

and in certain German publications referred to therein. In general terms one may say that, provided the records are used with carefully designed apparatus, they are capable of forming an inexpensive standard source of either acoustical or electrical vibrations over the very wide frequency range of some eight and a half octaves.

In conclusion, it may be noted that in the ordinary commercial electrical record now made to be played upon a mechanical gramophone, the grooves represent fairly accurately the original sound over a frequency range from 60 to 6000 vibrations per second, and especially so over the range from 200 to 4000 vibrations per second. This achievement is largely due to the comprehensive acoustical researches carried out in the Bell Telephone Laboratories, New York, and details will be found in the important paper by Maxfield and Harrison, "Methods of High Quality Recording and Reproduction of Music and Speech based on Telephone Research" (*Jour. Am. Inst. El. Engineers*, **45**, pp. 243-253; 1926).

W. H. GEORGE.

Marine Biology in Ceylon.

THE Administrative Report of the Marine Biologist for 1927, Part IV. Education, Science, and Art (F.), by Dr. Joseph Pearson, November 1928, Ceylon, includes reports by the assistant marine biologist on the pearl fishery, Gulf of Mannar; window pane oyster fishery; chank fishery and trawling survey with statistics, and by the second assistant marine biologist on field and laboratory work with notes on fishes and fishery problems. The work was done under the supervision of the marine biologist, Dr. Joseph Pearson, who contributes the introduction and reports on the research vessels *Nautilus* and *Violet*, with suggestions for suitable fishery vessels and a fishery base.

The report on the pearl fishery is very interesting, showing how quickly conditions change, and that whereas in 1926 in Donnan's Muttuwarattu Paar, which was specially investigated, the oysters were much on the decrease, in the spring of 1927, owing to supplementing of the original stock by drift oysters, they were in much greater numbers, again decreasing in the autumn. A discussion relative to the age of these oysters shows that they seldom live so long as five years, and that they should be fished at three and a half years on this particular paar, and probably on others. This is a very low age estimate compared with that of previous workers.

The chank fishery is apparently peculiar in that there is no substantial diminution in the yearly yield however much it is fished. No details are known with regard to the rate of growth and habits of this animal, and more research is needed.

The important and valuable fishing banks known as the Pedro and Wadge Banks up to 1927 had no charts of any kind. The trawling survey was begun in August 1927, and a Petersen grab is on order for bottom sampling. The figures for the analysis of the trawls are not quite correct, but an average of 207 fish per hour is taken as a low estimate, only fish of first-class edible quality being included. Assuming 20 hours trawling per day, this would give a daily catch of 4140 lb., or approximately 36 cwt. A much larger average is probably possible. Two important features are (1) that the catches are made up of a restricted number of species, which are of a convenient size both for storage and for market, and are equal in edible qualities to any tropical fish now marketed, and (2) there is very little waste. *Lethurus* (sea bream) comes first in numbers, 29 per cent, and *Lutianus* (snapper) second, 23 per cent.

The trawling investigations made by the Department in the seas around Ceylon are promising, particularly on these two banks described. These are the only trawling grounds so far discovered in Indian waters which show promise of successful exploitation. A fish-trawling company was floated in 1926, and during the year under review the company laid down one trawler which was expected to arrive in Ceylon about the middle of 1928. Twenty-seven per cent of the capital of this company has been subscribed by the Sinhalese.

It is a difficult matter to devise suitable boats for the inshore fishermen. This problem is now under consideration.

Much more research is needed into the economic problems, especially on the habits and life-histories of the principal food fishes, and there is abundant room for many more workers.

Theoretical Investigations of Ocean Currents.

THE mathematical investigations of Prof. V. W. Ekman into the dynamics of ocean currents have been directed chiefly to the study of 'type problems'; in these, friction is taken into account, but simplifying assumptions are made as to differences of density, the extent of the field, etc., so that his methods do not lead to quantitative results. He has now given us a non-mathematical account of his later work ("A Survey of Some Theoretical Investigations of Ocean Currents." *J. du Cons. Perm. Internat. pour l'Exploration de la Mer*, **3**, No. 3, p. 295, 1928), in which he shows what modification of his earlier results is necessary.

Starting from the well-known pseudo-force due to the rotation of the earth, which acts on a moving particle directly as its mass and velocity if the latitude is constant, he shows that, conversely, a particle which is acted upon by a constant force and is not otherwise constrained, will move at right angles to the force *cum sole*; its velocity, the 'normal velocity', and not the acceleration, will vary directly as the force. The original theory of the 'pure drift current' is modified by no longer assuming that the 'coefficient of virtual viscosity' is invariable, but no important change results; the spiral is still developed, but it is no longer equiangular, and the angle of surface deflection is not exactly 45°. Unlike the drift current, a slope current extends to the bottom, so that it is necessary to assume a layer in which bottom friction is effective; its thickness is the 'lower depth of frictional influence', corresponding with, but not equal to, the 'upper' depth. It is only in this lower layer that any transport of water in the direction of the slope takes place.

Out of this arise Prof. Ekman's recent investigations into the 'deep current' which lies above the bottom layer, and the effect on it of the topography of the bottom. A deep current running in the direction of increasing depth will experience a rotation *contra solem*. Further, since the velocity of the deep current increases from the pole to the equator, it will experience a rotation *cum sole* when directed towards increasing latitude.

These conclusions require some modification, the

amount of which is not quite certain. They depend upon the neglect of the acceleration of the current, which is not justifiable during the first few hours after the establishment of a slope, but they may be summed up as follows: A deep current tends to follow the parallels of latitude in low latitudes and the contour lines of the bottom in high latitudes. If the bottom topography is irregular, the current will tend to turn *contra solem* when running towards deeper water, and *cum sole* when the flow is towards smaller depths.

In conclusion, it is shown that convection currents may be discussed in some cases by the method of type problems. They are largely confined to the upper layers, so that we may assume a homogeneous deep layer on which the currents of the upper layer act as the winds act upon the surface of the sea, through the medium of a separating layer for which the name 'internal drift current' is proposed.

University and Educational Intelligence.

CAMBRIDGE.—E. G. Williams, of Trinity College, has been elected to an Isaac Newton Studentship, and F. L. Arnott, research student of Trinity College, has been elected to an additional Isaac Newton Studentship.

P. I. Dee, Taylor Research Fellow of Sidney Sussex College, has been elected to the Stokes Studentship at Pembroke College.

The degree of Sc.D. (*honoris causa*) has been conferred on Sir James Alfred Ewing, formerly professor of mechanism and applied mechanics in the University and until recently Principal and Vice-Chancellor of the University of Edinburgh.

EDINBURGH.—At the meeting of the University Court on Oct. 28, intimation was made of a benefaction by Mr. T. B. Macaulay to the Department of Animal Genetics. The endowment will provide an income of about £1100 a year, which is to be used for the provision of salaries for a special lectureship (the Macaulay lectureship) and associated assistantships. Mr. Macaulay has given a further sum of £1000 a year for the next five years toward the cost of researches of this group, and has offered to contribute £5000 for the purchase of a farm for the Department. The Court has expressed its appreciation of this latter proof of Mr. Macaulay's valued and helpful interest in the Department, and a special sub-committee has been called into being for the purpose of seeking full information as to the additional commitments that must be undertaken if a farm should be acquired.

Mr. Macaulay, the president and managing director of the Sun Life Assurance Company of Canada, has done much for the island of Lewis, the home of his forebears, having endowed a hospital and library, a peat research farm, and an educational trust. More recently he has endowed a soils research institute in Aberdeen.

GLASGOW.—At a meeting of the General Council of the University on Oct. 30, Sir Donald MacAlister was unanimously elected Chancellor in succession to the late Lord Rosebery. The University is thus to be congratulated upon retaining in high office one who has rendered it splendid services during his long tenure of the principalship. Since the middle of the seventeenth century the holder of the office of chancellor has always—except during a short break between 1875 and 1878—been a peer either temporal or spiritual, but apart from mere titular rank it will be felt that the new Chancellor is no unworthy successor to the long line of distinguished men who have previously held this office, including as his immediate predecessors Kelvin and Rosebery.

The office of Principal, vacated by Sir Donald MacAlister, has now been filled by the appointment of Prof. R. S. Rait, and the appointment is viewed with much pleasure by his numerous friends within and outside the University. Principal Rait, a former fellow and tutor of New College, has occupied since 1913 the chair of Scottish history and literature and is also Historiographer-Royal for Scotland. In addition to being president of the Senatus Academicus, the principal of a Scottish university becomes also in practice the chairman of the governing body or University Court, as the rector, its official president, is usually non-resident. The new principal has thus before him great responsibilities, but his task will be rendered lighter through the affairs of the University being handed over to him by one who is commonly regarded as the most able university administrator of our time.

LONDON.—The Senate, with the concurrence of the Court, has appointed Dr. Edwin Deller, previously Academic Registrar in the University, to the post of Principal of the University as from Oct. 1, 1929, in succession to Dr. T. Franklin Sibly, now Vice-Chancellor of the University of Reading.

THE seventeenth election to Beit Fellowships for scientific research, tenable at the Imperial College of Science, will take place on or about July 15, 1930. Not more than three Fellowships will be awarded, each of the annual value of £250. Candidates must be of European descent and less than twenty-five years of age at the time of election. Applications must be received on or before April 15, 1930. Further information can be obtained, by letter only, from the Rector, Imperial College, South Kensington, London, S.W.

EDUCATIONAL experiment and research in tropical and sub-tropical areas will be stimulated, encouraged, guided and rendered increasingly efficacious by a new journalistic venture of the Colonial Office. On Oct. 24 appeared the first number of *Oversea Education*, a quarterly journal published for the Secretary of State for the Colonies by the Oxford University Press (1*s*. Annual subscription, 4*s*.). Although produced primarily for the benefit of the Colonies, it will appeal to and draw material from all countries where education is studied in a scientific spirit. This first number includes articles on methods of compulsory education in the Tonga Islands, village schools in Palestine, the educational work of the Empire Marketing Board, and the development of indigenous arts and crafts (by Prof. Rothenstein), a vivid personal narrative by a native graduate of one of the 'Jeanes' schools established by Colonial governments in Kenya, Nyasaland, and Northern Rhodesia for the training of selected village school teachers as missionaries of rural culture, notes on bilingualism in Wales, recommendations relating to rural education from the report of the Royal Commission on Agriculture in India, 1928, Mr. J. L. Sibley's work in Liberia, proposals for unifying the scripts of the 743 languages and dialects of India, and the visual instruction work of the Royal Empire Society's Imperial Studies Committee. It has also reviews by competent authorities of books on educational developments in Africa, India, and Ceylon. "Rural Science", a handbook for teachers in Ceylon schools, reviewed by Mr. R. H. Stoughton, formerly Mycologist, Rubber Research Scheme, Ceylon, illustrates the new government policy of giving a rural bias to the entire educational system of the island. An introductory article is contributed by the Right Hon. W. Ormsby Gore. The journal can scarcely fail to accomplish by publicity and co-ordination of effort a notable advance towards the objects for which it has been instituted.

Calendar of Patent Records.

November 11, 1847.—The discovery that coal-tar contained benzene was made by A. W. Hofmann, but the production of benzene from coal-tar on a commercial scale was due to Charles Blackford Mansfield, a pupil of Hofmann's, and dates from the patent granted to him on Nov. 11, 1847, for "An improvement in the manufacture and purification of spirituous substances and oils applicable to the purposes of artificial light and various useful arts". Mansfield died as a result of burns received whilst he was carrying out some of his experiments on tar.

November 11, 1896.—The Bowden wire method of transmitting motion, so widely used in connexion with the operation of brakes and other parts of bicycles, was the invention of E. M. Bowden and was patented by him on Nov. 11, 1896.

November 12, 1673.—The patent granted to William Chamberlayne on Nov. 12, 1673, for his "new art or mistery of plating and tynninge of iron, copper, steele, and brasse, and for the compressing and plateing of all other mettalls; hee never yett useing or putting them in practize by reason of his long imprisonment and troubles in the late intestine warrs and since", was a confirmation of a previous grant made in 1661 to Chamberlayne and Dud Dudley. Chamberlayne did not put his invention into practice, and the patent is referred to by Andrew Yarranton in his "England's Improvement" as one which obstructed the introduction of the tin-plate industry into England from Saxony, which he had visited to obtain knowledge of the process of manufacture employed there. The industry was not established here until the beginning of the eighteenth century.

November 12, 1723.—On Nov. 12, 1723, a patent was granted to Ambrose Godfrey, a chemist at one time employed by Robert Boyle, for a new method of extinguishing fires. He used "a small portion of gunpowder closely confined; which when animated by fire acts by its elastic force upon a proper medium and not only divideth it into the minutest atoms but disperseth it also in every direction so as immediately to extinguish any fire within a certain distance. This medium is a liquor strongly impregnated with a preparation of antiphlogistic principles." A test of Godfrey's invention was successfully made before the Society of Arts on a house built for the purpose in Tottenham Court Road.

November 13, 1800.—The method of making cast steel by melting malleable iron with charcoal or other carbonaceous material in a crucible was first used in Sheffield by David Mushet, who patented the process on Nov. 13, 1800. Mushet was the first practical man in England to write on the manufacture of iron and steel.

November 14, 1835.—Joseph von Hohenblum was granted an Austrian patent on Nov. 14, 1835, for a system of pneumatic dispatch for postal packets, the letters being placed in small cylinders which were to be carried through long tubes by compressed air. The first successful installation of such a system was, however, first made in London about 1853.

November 15, 1747.—The famous fever powders of Dr. Robert James, "sold, wholesale and retail by John Newberry, bookseller, at the Bible and Sun, in St. Paul's Churchyard", were patented by James on Nov. 15, 1747. Patronised by Royalty, recommended by Horace Walpole, and its praises sung by the poets, nearly three million doses, Dr. James tells us, of the powder had been sold or distributed by 1764. In 1753 the Privy Council were petitioned to vacate the patent on the ground that the invention had been obtained from a Baron Schwanberg, but the petition was refused.

Societies and Academies.

LONDON.

Geological Society, Oct. 23.—**R. D. Oldham**: Historic changes of level in the delta of the Rhone. (1) At the opening of the Pleistocene period the whole area was covered by a deposit of gravel and well-rounded boulders, over which the Rhone and its tributaries wandered, with no fixed bed and with a velocity of current that gave them a torrential character. (2) A period of subsidence followed, the gradient and the speed of current were diminished, and an alluvial delta built up, which was at least as extensive as that of the present day. Two stages can be recognised in this deposit. (3) A period of uplift then set in, and the land rose, not less than 14 metres, above the level to which it had sunk, the deposits laid down were exposed to denudation, and an undulating surface of erosion was developed. On this weathered surface the settlements and structures of the Romans were erected. (4) Finally came another period of subsidence, which took place at intervals. One of these periods of subsidence probably took place between the years 1000 and 1500 B.C. The next change took place in the course of the eighth and ninth centuries; it amounted to about 5 metres of vertical displacement. Finally, there was a fresh movement of subsidence, practically completed during the later half of the eighteenth century. The total amount of these movements of subsidence was about 10 metres, and at the end of them the land still stands about 4 metres, or more, above the lowest level reached before the period of uplift set in.—**R. W. Pocock**: The *Petalocrinus* Limestone horizon at Woolhope (Herefordshire). The crinoid *Petalocrinus* has been recorded from Sweden and North America, but not hitherto from Britain. Its most striking peculiarity is the fusion of the arms into five solid arm-fans or petals, which radiate from the dorsal cup. The arm-fans are usually found detached in the limestone, throughout which they are profusely scattered. A bed of large tabulate corals on which the *Petalocrinus* band rests is found in this association throughout the outcrop. The combined thickness of the crinoid and coral-beds varies between 3 in. and 6 in. Llandovery rather than Wenlock affinities are indicated by the fauna of the transition-beds. The area appears to have been subjected to pressure, mainly along a north-west and south-east axis, developing thrust-faulting approximately at right angles to that axis; a late Coal Measure age is suggested for the principal movements. At May Hill and at Malvern the *Petalocrinus* Limestone with its associated coral-beds has been detected at the same horizon as at Woolhope.—**P. K. Ghosh**: The Carnmenellis granite: its petrology, metamorphism, and tectonics. This granite, which occupies an area of some 50 square miles between Falmouth and Camborne (Cornwall), was divided by the Geological Survey into (1) an earlier coarse variety and (2) a later fine variety. The coarse granite of the Survey has been subdivided into three types, which prove to be three distinct intrusions. The petrological characters of the granites and their differentiates are described. Analyses have also been made of the associated metamorphic rocks; these consist of 'green-stones', slates, and schists of various types, as well as inclusions of country-rock within the granite.

PARIS.

Academy of Sciences, Sept. 9.—**E. Fichot**: The waves of Poincaré in a winding canal.—**Paul Vuillemin**: Mycoses of the epidermis. The author distinguishes

two types of mycosis, hyphomycoses and brachymycoses, and gives examples of each type.—**Ed. Chauvenet** and **J. Davidowicz**: Zirconium iodide, zirconium oxyiodide hydrate, $ZrOI_2.8H_2O$, prepared by the evaporation of the solution of hydrated zirconia in hydriodic acid, gives the volatile compound H_2ZrI_6 on heating. The latter decomposes on heating into HI and ZrI_4. The tetraiodide can also be prepared by the direct interaction of the metal (95 per cent Zr) and iodine at a red heat.—**Ph. Joyet-Lavergne**: An experimental demonstration of the laws of cytoplasmic sexualisation.

Sept. 16.—**H. Deslandres**: The magnetic field of the sun, general and external. A discussion of work done at the Mount Wilson Observatory, and of communications by Chapman and by Evershed, with reference to the author's work on the magnetic fields of the sun since 1911.—**Marin Molliard**: The physiological characters presented by *Sterigmatocystis nigra* when lacking zinc and iron. The omission of iron and zinc from the culture medium of this mould causes much slower development, and this is connected with the production of citric acid and of soluble starch. It could not be definitely settled whether these two metals were absolutely indispensable for growth.—**A. Desgrez** and **P. Régnier**: The experimental study of the action of Evian water in cases of induced nephritis.—**N. Lusin**: The points of unicity of a measurable ensemble *B*.—**B. Lyot**: The polarisation of the planet Mercury.—**Mlle. L. S. Lévy**: The probable rôle of the complex ammonia compounds in the adsorption of copper and nickel salts by ferric hydroxide.—**Mme. N. Demassieux**: The action of the alkaline carbonates on lead bromide, iodide, and nitrate in aqueous solution. The iodide and bromide resemble the chloride in forming precipitates of lead bromocarbonate and lead iodocarbonate when alkaline carbonate is gradually added. Lead nitrate behaves differently, lead carbonate being the only product.—**J. Vellard** and **Miguelotte Vianna**: Modifications of the blood coagulation in the course of experimental yellow fever in *Macacus rhesus*. The results resemble those obtained with man. The modifications of the blood coagulation are of the same nature, but less accentuated and slower in the ape.

Sept. 23.—**Rodolphe Raclis**: A formula of summation.—**Akitsugu Kawaguchi**: The different connexions of functional space.—**Krawtchouk**: The approximate solution of linear differential equations.—**Mlle. Nina Bary**: Functions possessing the *N* property.—**Georges Durand**: The Cantor-Minkowski construction in space.—**Georges Bouligand**: Problems connected with the idea of the Georges Durand envelope.—**M. Gunther**: An application of the integrals of Stieltjes to the problem of Neumann.—**Alfred Rosenblatt**: On certain plane stationary movements of incompressible viscous fluids.—**R. Mazet**: An empirical formula giving the distribution of the yield at the surface of a circular orifice.—**A. Auric**: An empirical formula giving the distances at which the successive rings of the nebular hypothesis are formed.—**P. Marti**: The submarine volcanic region of the Catwick Islands.—**Takeuchi**: The average force exerted by the stationary vibration of a string on a ring through which the string passes.—**G. Athanasiu**: The influence of temperature on the photovoltaic electromotive forces. All the photoelectric cells studied showed an increase in the electromotive force when the temperature fell. The magnitude of the temperature coefficient proved the impossibility of explaining photovoltaic currents by identification with external photoelectric emission.—**J. Perreu**: The determination of the heats of dilution of hydrated salts (second method).—**R. Levaillant**: The conversion of alkyl sulphites into chlorsulphonic esters and into the neutral sulphates. The alkyl sulphites, treated at low temperatures with chlorine, give good yields of the corresponding chlor-sulphonates. At high temperatures the latter react with alkyl sulphites, giving nearly quantitative yields of the sulphates.—**Hans Fischer** and **Albert Kirrmann**: The synthesis of some mesoporphyrins.—**Henri Mémery**: The summer of 1929 and the solar variations. The sustained high temperatures during August and September of this year correspond with a marked increase in the number of sunspots during the same period.—**Peirier**: The Caloncoba, from the Cameroons, giving an oil with curative properties against leprosy.

VIENNA.

Academy of Sciences, June 13.—**H. Przibram** and **L. Brecher**: Growth measurements of *Tenodera aridifolia*, a Japanese mantis. There are eight or exceptionally nine changes of skin. The fasting weight was doubled after the seventh, eighth, and ninth moults. Successive cast-off skins are about double in weight.—**A. Brukl**: The quantitative analysis of gallium (3). Titanium is precipitated free from gallium from an oxalic acid solution by means of copper. Larger quantities of titanium with zirconium are precipitated by phenyl-arsenic acid. Oxyquinolin separates gallium from vanadium.—**A. Kailan** and **K. Hexel**: Velocity of esterification of mono-brom-acetic acid with glycerinic and ethyl-alcoholic hydrochloric acid.—**W. J. Müller** and **K. Konopicky**: The theory of passivity effects (6). The passivity of chromium at low current densities.—**E. Schrenzel**: Curves with isotropic normals.—**J. Pollak, E. Gebauer-Fülnegg,** and **E. Blumenstock-Halward**: β-naphthol-disulphochlorides.—**J. Pollak** and **E. Riess**: Oxythiophenols (2).—**E. Gebauer-Fülnegg** and **A. Glückmann**: α-naphthol-sulpho-acids.—**E. Riess** and **R. Hübsch**: Some new thiazol derivatives.—**C. Drucker**: Experimental contributions to the problem of electrolytic dissociation.—**C. Marie** and **G. Lejeune**: The solubility of ether in concentrated solutions of some mineral acids.—**F. Skaupy**: Grain limit and grain magnitude, their importance for some scientific and technical questions.—**F. Kaufler**: Crotonic acids.—**O. Fürth** and **H. Kaunitz**: The oxidation of some physiological substances by animal charcoal.—**N. Fröschl** and **J. Zellner**: Fungus resins.—**E. Dittler**: The degrees of oxidation of titanium in silicates. In titaniferous silicates a part or the whole of the titanic acid can be replaced by the next lower oxide of this metal. By synthesis it was shown that in silicates not only silicic acid but also the sesquioxide to a considerable extent may be replaced by TiO_2 or Ti_2O_3 respectively.—**K. Menger**: The foundation of an axiomatic theory of dimension.—**A. Dadieu** and **K. W. F. Kohlrausch**: Studies on the Raman effect (3). Attempts to interpret the Raman spectrum.—**S. Meyer**: The representation of the packing effects of the atoms.

June 20.—**A. Kailan** and **W. Antropp**: The esterification velocities of chloro- and fluoro-benzoic acids, of phthal-ethyl-esteric acid and abietinic acid with ethyl-alcoholic hydrochloric acid.—**A. Haas**: The deduction of Boltzmann's law of entropy by means of the concept of matter-waves.—**G. Horvath**: Rhyncotes from Palestine and Syria.—**K. Lohberger**: More fish from the Thian-Shan.—**K. Lohberger**: Some still undescribed fish forms from the Thian-shan.—**A. Soltys**: Iosene, a new hydrocarbon from Styrian brown coal. Formula $C_{20}H_{34}$, melting point 74°.

— A. Soltys: Three compounds extracted from Styrian brown-coal with petrol-ether: a compound, $C_{30}H_{50}O$, melting point 256°, and a fluid, $C_{15}H_{26}$, boiling point 265°. — R. Weiss and J. Reichel: Triphenyl-methanes, the benzene nuclei of which are interconnected (5). The di-methylene-triphenyl-carbinol-diketone. — L. Mirskaja: Repair processes in longitudinally split stems of *Mirabilis Jalapa*. —W. Feldmann: The growth of the stem parts in *Phaseolus coccineus* seedlings with the primordial leaves cut off or kept in the dark. Either process and likewise the reduction of the carbon dioxide content of the atmosphere leads to an increase in the growth of the stem.—A. Kailan: Chemical actions of penetrating radium radiations (18). The action on acetyl- and benzoyl-chloride. Considerable changes of specific conductivity are probably due to secondary reactions.—L. Kober: Contributions to the geology of Attica.

Official Publications Received.

BRITISH.

Ministry of Health. Advisory Committee on Water: Second Report of Legislation Sub-Committee. Pp. 82. (London: H.M. Stationery Office.) 9*d*. net.

North-East Coast Institution of Engineers and Shipbuilders (Incorporated), Bolbec Hall, Newcastle-on-Tyne. Report of the Council, 1928–9. Pp. 18. (Newcastle-on-Tyne.)

Journal of the Royal Society of Western Australia. Vol. 13, 1926–1927. Pp. xvi+88+29 plates. (Perth.) 25*s*.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 8-9, August–September 1929. Abstracts Nos. 1561-1982. Pp. v+287-350. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

University College of North Wales. Calendar for Session 1929–30. Pp. 392. (Bangor.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on October 17th, 1929. Pp. 8. (London.)

Nickel Steel, Series A, No. 3: Nickel Alloy Steels in High Performance Internal Combustion Engines. By T. Henry Turner. Pp. 12. (London: The Bureau of Information on Nickel, Ltd.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 30th October 1929. Pp. 41. (Newcastle-upon-Tyne.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1929; with Report of the Director of Fuel Research. Pp. viii+127. (London: H.M. Stationery Office.) 2*s*. net.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 14, Parts 3 and 4, 14 October. Pp. 181-335. (Cambridge: At the University Press.) 15*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1246 (Ae. 399): Measurement of Landing Loads. By E. T. Jones. (T. 2779.) Pp. 8+5 plates. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Institution of Great Britain. Vol. 26, Part 1, No. 123. Pp. 134. (London.) 10*s*. 6*d*. net.

Indian Statutory Commission. Interim Report of the Indian Statutory Commission (Review of Growth of Education in British India by the Auxiliary Committee appointed by the Commission), September 1929. (Cmd. 3407.) Pp. xxxiii + 401. (London: H.M. Stationery Office.) 4*s*. net.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1928. Pp. vi+110. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1928–29. Pp. 42. (London.)

India Meteorological Department. Scientific Notes: Vol. 1, No. 4: On Temperatures of Exposed Rails at Agra. Note prepared by Dr. K. R. Ramanathan. Pp. 37-48. 8 annas; 10*d*. Vol. 1, No. 5: Frequency of Thunderstorms in India. Pp. 49-55+1 plate. 6 annas; 8*d*. Vol. 1, No. 6: Correlations between Pre-Monsoon conditions over North-West India and subsequent Monsoon Rainfall over North-West India and the Peninsula. By Rao Saheb Mukund V. Unakar. Pp. 57-67. 6 annas; 9*d*. (Calcutta: Government of India Central Publication Branch.)

Colony and Protectorate of Kenya. Forest Department Annual Report, 1928. Pp. 32. Forest Department Pamphlet No. 2: The Influence of Forests on Climate and Water Supply in Kenya. By J. W. Nicholson. Pp. 40. (Nairobi.)

Oversea Education: a Journal of Educational Experiment and Research in Tropical and Subtropical Areas. Vol. 1, No. 1, October. Pp. 32. (London: Oxford University Press.) Quarterly, 1*s*.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 40, Part 3, 22nd October. Pp. 197-306. (London: Edward Stanford, Ltd.) 5*s*.

University of London: University College. Calendar, Session 1929–1930. Pp. 18+lxxx+493+lxxxi-ccviii+19-36. (London.)

Board of Education. Report on the Science Museum for the Years 1927 and 1928. Pp. 35. (London: H.M. Stationery Office.) 1*s*. net.

Canada. Department of Mines: Mines Branch. Comparative Tests of various Fuels when burned in a Domestic Hot-Water Boiler. By E. S. Malloch and C. E. Baltzer. (No. 705.) Pp. v+92+5 plates. (Ottawa: F. A. Acland.) 20 cents.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929. Vol. 41, October. Pp. 621-685. (London.)

Proceedings of the Liverpool Geological Society. Session the Seventieth 1928–1929. Part 2, Vol. 15. Edited by C. B. Travis. Pp. xiii+111-178+plates 3-7. (Liverpool.)

Some Problems of the Medical Profession in India. Compiled by Kumud Sankar Ray. Pp. vii+88. (Calcutta: All-India Medical Association.)

Journal of the Indian Institute of Science. Vol. 12A, Part 9: The Activated Sludge Process of Sewage Treatment; Report on the Working of the Plant at the Indian Institute of Science, Bangalore. By N. Swaminathan. Pp. 131-151. 1.4 rupees. Vol. 12A, Part 10: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.), Part 6: Nitrogen Metabolism in Healthy and Spiked Sandal Leaves. By N. Narasimhamurthy and M. Sreenivasaya. Pp. 153-163. 12 annas. Vol. 12A, Part 11: Lengthened *Ortho*-Di-Derivatives of Benzene and their Ring-Closure; Formation of Polymembered Heterocyclic Compounds from Substituted Phenylene-Dicarbamides. By Tejendra Nath Ghosh and Praphulla Chandra Guha. Pp. 165-178. 12 annas. Vol. 12A, Part 12: Oil from the Seeds of *Sapinus trifoliatus* (Linn.). By D. R. Paranjpe and P. Ramaswami Ayyar. Pp. 179-184. 6 annas. (Bangalore.)

Ceylon. Administration Report of the Director of the Colombo Museum for 1928. By Dr. Joseph Pearson. Pp. F16 + 7 plates. (Colombo: Government Record Office.) 70 cents.

Memoirs of the Geological Survey of India. Vol. 52, Part 2: The Aluminous Refractory Materials; Kyanite, Sillimanite and Corundum in Northern India. By Dr. J. A. Dunn. Pp. iv+145-274+xxi+plates 15-27. 5.8 rupees; 9*s*. Palaeontologia Indica. New Series, Vol. 10, Memoir No. 3: Les couches à cardita Beaumonti. Fascicule 2: Les couches à cardita Beaumonti dans le Sind. Par Prof. Henri Douvillé. Pp. iv+27-73+plates 5-11. 4.8 rupees; 7*s*. 6*d*. (Calcutta: Government of India Central Publication Branch.)

Gold Coast Colony. Report on the Survey Department for the Financial Year 1928–1929. Pp. ii+27. (Accra: Government Printing Office; London: The Crown Agents for the Colonies.) 2*s*.

Nigeria. Annual Report on the Agricultural Department for the Year 1928. Pp. 24. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2*s*.

FOREIGN.

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 24, Part 4: Physico-chemical Investigation on the Casein-splitting Action of Papain with Special Reference to the Fundamental Properties of its Action as well as to the Mechanism of the Acceleration of HCH Solution upon its Action. By Shōichi Satō. Pp. 101-151. (Tokyo: Maruzen Co., Ltd.)

University of Illinois Engineering Experiment Station. Bulletin No. 194: Tuning of Oscillating Circuits by Plate Current Variations. By Prof. J. Tykocinski-Tykociner and Ralph W. Armstrong. Pp. 51. (Urbana, Ill.) 30 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 18, No. 15: Drepania, a Genus of Nudibranchiate Mollusks new to California. By F. M. MacFarland. Pp. 485-496+plate 35. Vol. 18, No. 16: Some Upper Cretaceous Foraminifera from near Coalinga, California. By J. A. Cushman and C. C. Church. Pp. 497-530+plates 36-41. (San Francisco.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 11, Livraison 1, Août. Pp. 153. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Instituto Nacional de Investigaciones y Experiencias Agronómicas y Forestales. Boletin Núm. 3: Instituto Forestal de Investigaciones y Experiencias; Trabajos de la Secciones hidráulica torrencial, combustibles vegetales, flora y mapa forestal, resinas. Pp. 142. (Madrid.)

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 45: Thirteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey of Connecticut, 1927–1928. Pp. 32+3 plates. 10 cents. Bulletin No. 46: The Physical History of the Connecticut Shoreline. By Henry Staats Sharp. Pp. 97+8 plates. 75 cents. (Hartford, Conn.)

Report of the National Committee on Calendar Simplification for the United States, submitted to the Secretary of State, Washington, August 1929. Pp. 119. (Rochester, N.Y.: National Committee on Calendar Simplification.)

Travaux de la Section de Géodésie de l'Union Géodésique et Géophysique internationale. Tome 6: Rapports généraux établis à l'occasion de la troisième assemblée générale, Prague, 29 août-10 septembre 1927. Pp. vi+6+7+60+33+32+13+28+4+10+6+17. (Paris.)

El tunel del estrecho de Gibraltar: Conferencia pronunciada el 25 de marzo de 1929. Por Sr. D. Rafael de Buen. Pp. 29. (Madrid: Real Sociedad Geográfico.)

Masarykova Akademie Prace: Académie Masaryk du Travail. Publication scientifique 47: Conférences faites en décembre 1925 à l'Université et à l'École polytechnique de Prague par le Col. Georges Perrier. Pp. 69. (Prague.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1, No. 10, Octobre. Pp. 521-570. (Prague: Regia Societas Scientiarum Bohemica.)

Department of Commerce: Bureau of Standards. Research Paper No. 88: Some Absorption Properties of Clay Brick. By L. A. Palmer. Pp. 105-127. (Washington, D.C.: Government Printing Office.) 10 cents.

The University of Colorado Studies. Vol. 17, No. 2: Non-Marine Mollusca of Oregon and Washington. By Junius Henderson. Pp. 45-190. (Boulder, Colo.) 1 dollar.

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102: Mededeelingen en Verhandelingen, 32. Het Klimaat van Nederland. C: Luchtdrukking; D: Wind. Door Dr. C. Braak. Pp. 158. (Amsterdam: Seyffardt's Boekhandel.) 1.50 f.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 192: Causes and Effects of Soil Heaving. By M. M. McCool and G. J. Bouyoucos. Pp. 11. Technical Bulletin No. 100: The Differentiation of the Species of the Genus Brucella. By I. Forest Huddleson. Pp. 16. Technical Bulletin No. 101: A Test for Water-Soluble Phosphorous; Studies on Water-Soluble Phosphorous in Field Soils. By C. H. Spurway. Pp. 25. (East Lansing, Mich.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico internationale 1900-0. Zona di Catania fra le declinazioni $+46^{\circ}$ e $+55^{\circ}$. Vol. 6, Parte 2^{a}: Declinaz. da $+51^{\circ}$ a $+53^{\circ}$, ascens. retta da 3^{h} a 6^{h}. (Fascicolo N. 42.) Pp. viii+36. L'Attività dell' Osservatorio nel 1928. Pp. 7. (Catania.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 23: American College Athletics. By Howard J. Savage and Harold W. Bentley, John T. McGovern, Dr. Dean F. Stanley. Pp. xxii+383. (New York City.) Free.

Festschrift für die 110 Jahresversammlung der Schweizerischen Naturforschenden Gesellschaft in Davos. Pp. 270+20 Tafeln. (Basel: Benno Schwabe und Co.) 9.60 gold marks; 12 Schw. francs.

Scientific Papers of the Institute of Physical and Chemical Research. No. 196: The Constituents of Matteucia Orientalis. By Shin-ichiro Fujise. Pp. 111-118. 20 sen. No. 204: Raman Effect on Organic Substances. By Yoshio Fujioka. Pp. 205-222+plates 10-16. 55 sen. No. 205: Slip-Bands of Compressed Aluminium Crystals. Part 1: Distortion of Single Slipping and a Tentative Theory of Work-hardening of Metal. By Keiji Yamaguchi. Pp. 223-241+plates 17-19. 45 sen. No. 206: Stark Effect for the Spectral Lines of Chlorine, Bromine and Iodine. By Kwan-ichi Asagoe. Pp. 243-250+plates 20-24. 35 sen. (Tōkyō: Iwanami Shoten.)

International Review of Educational Cinematograph. Year 1, No. 1, July 1929. Pp. 116. (Rome: International Educational Cinematographic Institute, League of Nations.)

Ministerio da Agricultura, Industria e Commercio: Observatorio Nacional do Rio de Janeiro. Boletim Magnetico do Observatorio Nacional, 1927 e 1928. Pp. 87. (Rio de Janeiro.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1598: Mountain Beavers in the Pacific Northwest; their Habits, Economic Status and Control. By Theo. H. Scheffer. Pp. ii+18. 5 cents. Leaflet No. 31: Termites in Buildings. By Thos. E. Snyder. Pp. ii+5. Miscellaneous Publication No. 51: National Wild-Life Reservations. Pp. 10. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 21: Industrial Education, 1926-1928. By Maris M. Proffitt. Pp. 24. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 75, Art. 19: A Revision of the Beetles of the Tenebrionid Tribe Usechini, with Descriptions of a New Genus and New Species. By Frank E. Blaisdell, Sr. (No. 2790.) Pp. 14+1 plate. (Washington, D.C.: Government Printing Office.)

Memoirs of the University of California. Vol. 9, No. 1: The Chromosomes in Man, Sex and Somatic. By Herbert M. Evans and Olive Swezy. Pp. 65 (11 plates). (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.50 dollars.

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 99: Thermoelectric Temperature Scales. By Wm. F. Roeser. Pp. 343-358. (Washington, D.C.: Government Printing Office.) 5 cents.

University Studies. Vol. 26, Nos. 1-2: Distribution and Structure of the Forests of Eastern Nebraska. By John M. Aikman. Pp. 75+19 plates. (Lincoln, Nebr.: University of Nebraska.)

CATALOGUES.

Catalogue of Optical Lanterns, Epidiascopes and other Projection Apparatus. Pp. 52. (London: Newton and Co.)

Spectrographic Outfits for Metallurgical Analyses: a Guide to the Choice of suitable Spectrographic Apparatus for a Technical Laboratory. Pp. 38. (London: Adam Hilger, Ltd.)

Catalogue of Recent Purchases of Rare, Uncommon and New Works on Botany (Horticulture, Floras, Herbals) and Zoology. (No. 10.) Pp. 20. (London: John H. Knowles.)

Diary of Societies.

FRIDAY, NOVEMBER 8.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—G. Smith: The Mildew Problem in the Cotton Industry.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. M. Green: The Indian Cinema Industry.

ASIATIC SOCIETY (jointly with Central Asian Society) (at Burlington House), at 5.—Sir Aurel Stein: Alexander's Campaigns on the North-West Frontier of India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. E. A. Milne: The Masses, Luminosities, and Effective Temperatures of the Stars.—Prof. A. S. Eddington: Internal Circulation in Rotating Stars.—Dr. H. Spencer Jones: A Revision of Newcomb's Occultation Memoir.—R. A. McIntosh: (*a*) The Meteor Swarm of Halley's Comet; (*b*) Observations of the Orionid Meteors.—Prof. A. S. Eddington and S. Plakidis: Irregularities of Period of Long Period Variable Stars.—Report of the British Expedition to Observe the Total Solar Eclipse of 1929, May 9.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. Sir C. V. Raman: Diamagnetism and Molecular Structure (Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30.—W. S. Stiles: The Nature and Effects of Glare.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Section) (at 36 George Street, Manchester), at 7.—E. M. Cass: Undue Compression in the Cylinders of Steam Locomotives and Means of Combating Same.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—H. Neilsen: Low Temperature Carbonisation of Fuel.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—J. Morris: Cotton Spinning and Doubling.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. Orme: Nickel-Silver.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. P. J. Cammidge: Retinitis in Diabetes.—T. Thomas and M. S. Mayou: Sarcoma of the Iris.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Reece's Café, Liverpool).—Dr. Fox: Some Reminiscences of a Government Laboratory.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Thomas' Café, Swansea).—H. J. Hodsman: Smokeless Fuels and how they burn.

NATIONAL SMOKE ABATEMENT SOCIETY (at College of Technology, Manchester).—A. McCulloch: Coal and its Combustion.

SATURDAY, NOVEMBER 9.

BIOCHEMICAL SOCIETY (in Department of Physiology, University, Liverpool), at 2.30.—Prof. T. P. Hilditch and G. Collin: Regularities in the Glyceride Structure of Vegetable Seed Fats.—H. Rogerson: The Haloid and Oxyhaloid Salts of Bismuth.—Prof. I. M. Heilbron and F. S. Spring: The Colour Reactions and Absorption Spectra of Sterols in Relation to Structure.—R. N. Morton, Prof. I. M. Heilbron, and F. S. Spring: Absorption Spectra in Relation to Vitamin A.—W. Ramsden and R. H. Hurst: The Spacings of Adsorbed Molecules.—L. Earlam: Denaturation of Methæmoglobin by Fat-solvents.—W. Ramsden, J. Brooks, and L. Earlam: De-solutions by Loose Association of Two Solutes.—A. Wormall: The Immunological Specificity of Halogenated and Nitrated Proteins.—A. J. Leigh: Observations on Hagedorn and Jensen's Blood Sugar Method.

MONDAY, NOVEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Papers on Stereographic Survey.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Dr. W. H. Hatfield: Steels for Automobiles and Aeroplanes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. E. Highfield and others: Discussion on Temporary Expedients in Engineering.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings electrically by means of Thermal Storage.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—H. W. T. Taylor: Voltage Control of Large Alternators.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Section) (at Borough Polytechnic), at 7.—Debate on Panel *versus* Direct Heating.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—H. T. Jones and J. S. Willcox: Fertilisers and Feeding Stuffs Act.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—J. D. Pratt: Rationalisation—its Meaning and Application.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. Mortimer: Some Difficulties in Aluminium Alloy Founding, and some Remedies.

TEXTILE INSTITUTE (Yorkshire Section) (jointly with Bradford Textile Society) (at Midland Hotel, Bradford), at 7.30.—Sir Lawrence Weaver: Co-operative Advertising for the Wool Industry.

MEDICAL SOCIETY OF LONDON, at 8.—Dr. J. A. Ryle, Dr. H. Orton, and Prof. E. C. Dodds: Discussion on The Different Methods of Diagnosis in Gastric Disease.

SURVEYORS' INSTITUTION, at 8.—C. H. Bedells: Presidential Address.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Comparative Anatomy Lecture Room), at 8.45.—Prof. E. Hindle: Recent Work on Yellow Fever.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol).

TUESDAY, NOVEMBER 12.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. G. F. Still: The History of Pædiatrics in the XVIIth and XVIIIth Centuries (Fitzpatrick Lecture).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Lieut.-Col. Sir Arnold T. Wilson: Oil Legislation in Central and South America.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. Harbottle: The Opposed Piston Oil Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—E. J. Evans: Feed Heating by Extracted Steam in Generating Stations.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with North-Western Centre of Institution of Mechanical Engineers) (at Engineers' Club, Manchester), at 7.—R. A. Chattock: The Modern Use of Pulverised Fuel in Power Stations.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—G. Morgan: Chairman's Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—J. Wallace: The Super-Sports Motor Cycle.

MANCHESTER COLLEGE OF TECHNOLOGY TEXTILE SOCIETY (at Manchester), at 7.30.—D. Atkinson: The Weaving of Fancy Cloths.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. R. Hay: Age-Hardening in Alloys.
QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. A. Robins: Spiders; Notes on their Life and Habits.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—E. E. Evans-Pritchard: Zande Witch-doctors.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (at Wellcome Historical Medical Museum), at 8.30.—Sir Robert Armstrong-Jones: Superstition.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. E. N. da C. Andrade: Modern Views of Matter (Lecture).

WEDNESDAY, NOVEMBER 13.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—C. Rowntree and others: Discussion on Complications of Operations for Piles.
INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—W. E. Prytherch: The Effect of some Impurities in Copper.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. S. Coates: Modern Boiler Practice. Part I.
ROYAL SOCIETY OF ARTS, at 8.—J. O. Boving: New Developments in Hydraulic Pneumatic Engineering.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—V. Henri: The Structure and Activation of the Molecule of Phosgene. An Analysis of the Ultra-Violet Absorption Spectrum of Phosgene Vapour.—Prof. T. M. Lowry and C. B. Allsopp: A Photographic Method of Measuring Refractive Indices.—C. P. Snow and Dr. E. K. Rideal: Infra-Red Investigations of Molecular Structure. III. and IV.—P. M. S. Blackett, P. S. H. Henry, and Dr. E. K. Rideal: A Flow Method for Comparing the Specific Heats of Gases.—*To be read in title only*:—Prof. H. Bateman: The Two Dimensional Motion of a Compressible Fluid.—Sir Almroth Wright: Further Studies on Intertraction.—J. H. Brinkworth: On the Temperature Variation of the Specific Heats of Hydrogen and Nitrogen.—Prof. L. J. Mordell: Kronecker's Fundamental Limit Formula in the Theory of Numbers and Elliptic Functions, and Similar Theorems.—R. W. Lunt and M. A. Govinda Rau: The Variation of the Dielectric Constants of Some Organic Liquids with Frequency in the Range 1 to 10 Kilocycles.—J. A. Hall: The International Temperature Scale between 0° and 100° C.—Dr. E. J. Williams: The Straggling of β-Particles.—W. H. Watson: The Effect of a Transverse Field on the Propagation of Light *in vacuo*.—Prof. J. W. McBain and C. R. Peaker: The Electrical Conductivity caused by Insoluble Monomolecular Films of Fatty Acid on Water.—F. P. Bowden: The Amount of Hydrogen and Oxygen Present on the Surface of a Metallic Electrode.—F. H. Schofield: The Melting Point of Palladium.—Prof. G. P. Thomson: Diffraction of Cathode Rays. III.—K. R. Rao: Regularities in the Arc Spectrum of Arsenic.—H. W. Thompson and C. N. Hinshelwood: The Kinetics of the Oxidation of Ethylene.—Dr. J. A. V. Butler and C. M. Robertson: The Behaviour of Electrolytes in Mixed Solvents. Part I.—F. W. P. Götz and Dr. G. M. B. Dobson: Observations on the Height of Ozone. II.—R. W. James, G. W. Brindley, and R. G. Wood: A Quantitative Study of the Reflexion of X-Rays from Crystals of Aluminium.—U. R. Evans and L. C. Bannister: The Growth of Silver Iodide Films.—Prof. W. E. Curtis and A. Harvey: Structure of the Band Spectrum of Helium. VI.—Prof. J. W. McBain and H. G. Tanner: A Robust Microbalance of High Sensitivity, suitable for Weighing Sorbed Films.—G. I. Finch and D. L. Hodge: Gaseous Combustion in Electric Discharges. IV.—Dr. A. Müller: A Spinning Target X-Ray Generator and its Input Limit.—R. H. Dalton and C. N. Hinshelwood: The Oxidation of Phosphine at Low Pressures.—Prof. O. W. Richardson and K. Das: The Spectrum of H_2: The Bands Analogous to the Ortho-helium Spectrum. II.—F. P. Bowden: The Kinetics of the Electric Deposition of Hydrogen and Oxygen.—J. Hume and L. Colvin: The Decomposition of Potassium Hydrogen Oxalate Hemihydrate.—C. J. Smith: A New Form of Calorimeter suitable for Determining Heats of Solution, with an Application to Worked and Annealed Metals. Dr. C. H. Desch: Appendix.—L. M. Swain: On the Turbulent Wave behind a Body of Revolution.—W. H. Barnes: The Crystal Structure of Ice between 0° C. and − 183° C.—Prof. J. C. McLennan, A. B. McLay, and M. P. Crawford: The Spark Spectrum of Thallium, Tl II—Term Analysis—Fine Structure of Lines.—D. M. Murray-Rust and Sir Harold Hartley: The Dissociation of Acids in Methyl and Ethyl Alcohol.—K. S. Krishnan: The Influence of Molecular Form and Anisotropy on the Refractivity and Dielectric Behaviour of Liquids.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. E. T. Whittaker: Parallelism and Teleparallelism in the Newer Theories of Space (Presidential Address).
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Rt. Hon. H. A. L. Fisher: An Oxford Movement (Lloyd Roberts Lecture).
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—R. P. Rowlands: A Review of the Surgery of the Gall-bladder and Bile Ducts (Bradshaw Lecture).
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Lady Cowan: The Child and the Cinema.
INSTITUTE OF METALS (Birmingham Local Section), at 7.—Discussion on Rolling.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with Nottingham Section) (at Victoria Station Hotel, Nottingham), at 7.30.—J. A. Reavell: The Scientific Heating of Liquids and Gases.
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—D. Stewart: Modern Developments in the Petroleum Industry.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—A. Erskine: The Economic Combustion of Coal.
INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 7.30.—H. L. Sulman: Mineral Flotation.
INSTITUTION OF WELDING ENGINEERS (at Caxton Hall), at 7.30.—Dr. W. M. Hampton: The Manufacture and Standardisation of Eye-Protective Glasses.
ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital, Queen Square, W.C.1), at 8.—Clinical Meeting.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch).—Eng.-Capt. J. J. Sargent: Practical Marine Engineering Problems.
BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH RÖNTGEN SOCIETY.

FRIDAY, NOVEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F. Hodgkinson: Journal bearing Practice.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. B. C. Laws: The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.
ROYAL SANITARY INSTITUTE (at Town Hall, Carlisle), at 7.30.—P. Dalton and others: Discussion on Town Planning of Built-Up Areas.—C. J. H. Stock and others: Discussion on Some Dangers and Difficulties of Small Water Supplies.—R. Simpson and others: Discussion on The Veterinarian in Relation to the Milk Supply.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. T. Griffiths: Nickel and its Uses in Engineering.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Special General Meeting.
TEXTILE INSTITUTE (Lancashire Section) (at Rochdale Technical School), at 7.30.—J. Ryan: The Problems of the Cotton Industry with special reference to the Spinners' Difficulties.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Nottingham Section).—J. A. Reavell: The Scientific Heating of Liquids and Gases.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff).—S. Dixon: Some Recent Food Investigations.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. F. A. Mason: Peter Griess.

SATURDAY, NOVEMBER 16.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—C. Fox: Mental Energy.
BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—Conference: Is there a Changing Trend in the Textile Industry?
PHYSIOLOGICAL SOCIETY (at Cardiff).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 8.

LONDON HOSPITAL MEDICAL COLLEGE, at 4.30.—Dr. A. F. Hurst: Precursors of Carcinoma of the Stomach (Schorstein Memorial Lecture.)

SATURDAY, NOVEMBER 9.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—G. T. Clark: Geometry—Boys, Girls, Us.
HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Wild Flowers in London's Open Spaces.

TUESDAY, NOVEMBER 12.

UNIVERSITY COLLEGE, at 6.30.—E. T. Elbourne: Engineering Management. (Succeeding Lectures on Nov. 19 and 26.)

WEDNESDAY, NOVEMBER 13.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dame A. Louise McIlroy: The Influence of Pathology upon Maternal Welfare.
SCHOOL OF ORIENTAL STUDIES, at 5.15.—H. A. R. Gibb: Ibn Battutah.
ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Sir Arthur Keith: Race Building, Past and Present.
KING'S COLLEGE, at 5.30.—Prof. E. Wilson: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Engineering.

THURSDAY, NOVEMBER 14.

KING'S COLLEGE, at 5.—Dr. W. Robson: Protein Metabolism. (Succeeding Lectures on Nov. 21, 28, and Dec. 5.)—At 5.30.—Dr. J. A. Williamson: The Cabots and the Discovery of the New World. (Succeeding Lectures on Nov. 21 and 28.)

SATURDAY, NOVEMBER 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: The Marvel of India's Canals.

CONFERENCE.

FRIDAY, NOVEMBER 15.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30.—Conference on the Growth of Winter Food for Livestock. In Chair, Lord Clinton.

J. G. Stewart, of the Ministry of Agriculture.
Harald Faber: The Danish Solution of the Problem.
Dr. H. E. Annett: The New Zealand Solution of the Problem.
W. B. Mercer and W. A. C. Carr: Winter Food for Dairy and Feeding Cattle.
Capt. R. Stallard: Winter Food for Dairy Cows.
T. C. Ward: Winter Food for Cattle.