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Culture and Chemistry.

CRITICISM is an art to which Prof. H. E. Armstrong, as is well known, has given some attention. The opportunity occurring on the occasion of his lecture before the Royal Society of Arts on "Marcelin Berthelot and Synthetic Chemistry"—a full report appears in the *Journal* of the Society of Dec. 30—for the exercise of that faculty, was employed, in the main, in a manner such as cannot fail to arouse appreciation. As Sir William Pope, who opened the subsequent discussion, remarked, it would have been an easy enough task merely to give an account of Berthelot's life and of his manifold scientific activities, but to present a picture which should indicate how that work fitted in with the great scheme of progress and led to the present situation was an entirely different matter. That such a picture should be presented by one who has lived through that great epoch and has himself taken part in many of the big movements to which he necessarily referred, invested the discourse with a special degree of importance.

So much has been said and written in recent months in praise of the undoubtedly tremendous influence of that master-mind on the progress of scientific thought and achievement, that one may be forgiven for welcoming the condiment of informed, if sometimes mordant, criticism and analysis. It is evident that Prof. Armstrong still has no use for our modern system of chemical education—a system which we all freely admit to be far from perfect, but scarcely to be jettisoned on that account. We do not read original literature. We do not strive to shape our style on that of our forefathers. Indeed, we are losing the conception of culture in that domain, he says. There is, we submit, no lack to-day of either genius or philosophy. True, there may be more 'pottering' than yesterday, but may not that be ascribed to a greater abundance of potential potterers, perhaps even more than to the "present low level of academic impotence"?

We should do well, moreover, not to ignore the fact that the outward and visible signs of scientific culture, no less than of social culture, change with the times; they cannot be unaffected by the evolution of socialism (with a small 's') from individualism. More and more, too, such is the luxuriant growth in the garden of knowledge, one is consciously or unconsciously influenced by a mass-effect rather than by an individual plant, however venerable. In assessing the real importance

of Prof. Armstrong's justifiable complaint, one may perhaps be permitted to take passing note of the other extreme of the matter, and to be reminded that there must be a modicum of truth in Mr. Stephen Leacock's amusing confession: "I'd like to take a large stone and write on it in very plain writing—'The classics are only primitive literature. They belong to the same class as primitive machinery and primitive music and primitive medicine,' and then throw it through the windows of a University and hide behind a fence to see the professors buzz!"

However, to return to the main theme of Prof. Armstrong's discourse, namely, Berthelot's pioneering labours at the foundations of our amazing modern edifice of synthetic chemistry. His multitude of thermochemical investigations was considered less worthy: "... he ceased to be a constructive artist; grasping the thermometer, he became a thermalist ... the slave of physical measurement." His work on biological problems and on chemical changes of importance to agriculture received less praise, although not quite so little as agricultural research of to-day. Berthelot's work in this subject "... shows him once more, in the main, as a chemist with undeveloped biological feeling." But in another field "it is clear that he set out upon his upward journey advisedly, bearing a banner inscribed with the device then entirely strange—'Organic Synthesis'"; alcohol, mustard oil, methane, acetylene, benzene, naphthalene, and anthracene were among the numerous compounds which were synthesised for the first time, and the idea of 'vital force' behind organic chemistry was disposed of for ever.

The very success of Berthelot's syntheses, suggesting that man may make all things, has done much, we are told, to hasten a debacle. To-day there is an "insensate desire" abroad to synthesise and manufacture everything. Prof. Armstrong becomes quite indignant at the idea of eating "margarine ... 'improved' with the aid of advitants from the livers of animals all and sundry." Berthelot, he declares, has given manufacturing chemists enough to do for some time to come without interfering with our food. In the discussion at the close of the lecture, however, Mr. Robert Mond put forward a point of view which might well be emphasised from the educational side: that in chemistry one can check one's own errors, and that chemistry *qua* chemistry may therefore be made the best tool for moral training that we possess.

Keeping Abreast—Some Aids for Physicists.

(1) *Radioaktivität.* Von Prof. Dr. Stefan Meyer und Prof. Dr. Egon Schweidler. Zweite, vermehrte und teilweise umgearbeitete Auflage. Pp. x + 722. (Leipzig und Berlin: B. G. Teubner, 1927.) 36 gold marks.

(2) *Thermionic Phenomena.* By Eugène Bloch. Translated by J. R. Clarke. Pp. viii + 145. (London: Methuen and Co., Ltd., 1927.) 7*s.* 6*d.* net.

(3) *Dielectric Phenomena: Electrical Discharges in Gases.* By S. Whitehead. Edited with a Preface by E. B. Wedmore. Published for the British Electrical and Allied Industries Research Association, being Reference L/T 22. Pp. 176. (London: Ernest Benn, Ltd., 1927.) 16*s.* net.

(4) *Institut International de Physique Solvay. Conductibilité électrique des métaux et problèmes connexes.* Rapports et discussions du quatrième Conseil de Physique tenu à Bruxelles du 24 au 29 avril 1924 sous les auspices de l'Institut International de Physique Solvay. Pp. viii + 368. (Paris: Gauthier-Villars et Cie, 1927.) 50 francs.

EVERY physicist must at some time or other have felt some sympathy with the suggestion, coming in the first place from an ecclesiastical source, that research laboratories should take a compulsory vacation of some ten years or so, in order that a breathing space might be given in which it would be possible to assimilate the vast accumulation of knowledge of the past few years, and to consider its bearings and implications not only in science but also in philosophy. In fact, with the slight and obvious reservation that nothing in the bill should be regarded as applying to one's own laboratory, a measure on such lines would undoubtedly meet with considerable support. It is pretty certain that no one in the future will be able to know the whole of physics, as it was possible to know it twenty or thirty years ago, or to keep in touch with all its developments even to the extent of reading, at first hand, the original memoirs in which the new work is described. At the same time, the actions and reactions of different branches of the subject upon each other are as close as, or closer than ever.

The problem is a serious one for the university teacher. It is absurd that a student of physics should go out from the university without some knowledge of the developments of his subject during the last ten or twenty years, and yet one searches in vain through the standard curriculum for some-

thing which can safely be scrapped. The problem for the research worker, who has less time for reading than the student, is equally vital. He knows that some new discovery in some widely different branch of the subject may illuminate his own problems, and yet if he attempts to read all the journals which pour out from the press, he will certainly have little time for experimental work. Some large commercial laboratories, we believe, maintain a member whose sole duty is to digest this mass of material and to distribute the nutriment to the particular parts of the body politic where it is most appropriate. Most of us, however, belong to less highly developed organisms, where functional differentiation has not been carried so far. We must buy our food predigested if possible, and we are very grateful if some specialist, with a reasonable gift for clear exposition, will spare sufficient of his time to tell us what is going on in the particular part of the subject which he has made his own. Text-books and monographs must play an ever-increasing part in the dissemination of knowledge in physics, and the author of a really good book of this kind has earned the gratitude of his fellow-workers.

(1) Meyer and Schweidler's "Radioaktivität," which was first published in 1916, established itself as the standard book on this subject from the moment when it became generally available. After a lapse of rather more than ten years we welcome it again in its second edition. The very large amount of new material which it contains makes it practically a new work. The authors record that the number of entries in the author index has increased from 749 to 1561, and the number of papers cited from 2460 to 4380. It is clear from these figures that a prodigious amount of new work has had to be incorporated in the volume in order to bring it once more up-to-date, and no worker in the subject can afford to remain ignorant of this accumulation of new facts and data.

It may be said at once that the authors have done their work well. They have a talent for selecting the vital part of the work which they describe, and for giving the essence of it in a form which is concise without being obscure. The numerical data are unusually full, and above all, the book is excellently documented, so that the worker has no difficulty in tracing any piece of information to its source, and so obtaining further details if he requires them. The publishers, too, have played their part well. The printing is excellent, and the paper so good that although many of the diagrams are very small, they are quite clear. The book is one which all workers in the subject will need to consult and most of them will wish to possess.

(2) Eugène Bloch's "Thermionic Phenomena" is already well known in its French dress. Many of us have been grateful, in the past few years, for the very valuable series of "Conférences-Rapports," of which the book in its original form was one, and M. Bloch's account of this rapidly growing and important subject is quite up to the high standard of the series. Messrs. Methuen and Co. now provide us with an English translation, which students who are unable to read the original will be very glad to possess. The account of thermionic phenomena in this volume is neither so complete nor so detailed as Meyer and Schweidler's treatise on radioactivity, but it is an excellent introduction (probably the best we have) to the subject. There are fairly numerous references to the original documents, and Mr. J. R. Clarke, who has translated the work into very readable English, has thoughtfully provided two indexes, which were wanting in the original.

(3) "Dielectric Phenomena" is a book of quite a new kind, though we may see more of its type in the future. It might almost be described as a phenomenon in itself. Published on behalf of the British Electrical and Allied Industries Research Association, its object is not only to give but also to seek information. The problem of insulation and insulators is becoming very critical nowadays. Plans for distributing electrical energy throughout the length and breadth of the land by a network of high-tension wires are now reaching maturity, and both for its safety and its efficiency the scheme must look to its insulators. Again, both in pure research and in medical work, there is a demand for higher and still higher voltages. The 100,000 volt apparatus which was practically standard in radiological departments a few years ago, is being replaced by sets capable of producing 200,000 volts, and there is no suggestion that the demand for 'volts' has reached its limits. Here, again, insulation is the vital problem.

The British Electrical and Allied Industries Research Association is clearly very much alive to the situation, and to the very unsatisfactory nature of our present knowledge of the subject. Mr. Whitehead, on behalf of the Association, has made, in this volume, a critical résumé of what is already known, or surmised on the subject, and one can only agree with his conclusion that there is scope for much more work, both experimental and theoretical.

Although our knowledge is admittedly very imperfect, Mr. Whitehead has succeeded in bringing together quite an important mass of data, much of it from periodicals which are not usually consulted by the physicist, and anyone interested either in insulation or in high tension discharge (for the book is mainly concerned with what happens when an insulator, and in particular a gaseous insulator, breaks down) will find here most of what there is to be known on the subject. This is, we believe, the first occasion on which a research association has published one of its précis for the benefit of scientific workers generally. Let us hope that they will reap a harvest of new discoveries.

(4) It is no disparagement to the authors of the volumes just reviewed to say that the most interesting has been reserved until last. Text-books and monographs are our necessary 'bread and butter' in these days; the reports of the triennial Solvay Conferences are real 'jam.' It is not so much the possession as the pursuit of knowledge which fascinates us; and the best written histories cannot rouse in us the same lively interest as a daily paper at a time when great events are afoot. In these Solvay reports we have, as it were, knowledge in the making; we can watch the interplay of experiment and hypothesis; and can even, as uninvited guests, enjoy the fun of speculating as to which, if any, of the numerous suggestions put forward by the eminent physicists present will prove to be nearest to the mark. The subject of the present report, "The Electrical Conductivity of Metals," lends itself particularly to this game, for there is scarcely any part of theoretical physics in which there is more uncertainty. Prof. Lorentz invites us to consider the electrons in the metal as constituting a perfect gas. Prof. Lindemann prefers to regard them as a perfect solid, and puts up a vigorous defence for his hypothesis. Prof. Bridgman, in a very excellent résumé of the subject, invites us to consider some dozen other theories, which have been mooted from time to time, besides suggesting a new one of his own. It is all very exciting, and excellent reading.

We should be wrong, however, if we left the impression that the volume was all 'jam.' Like its predecessors, this Solvay report contains some of the best summaries which we have of the present state of knowledge in the subjects with which it deals. In addition to Prof. Bridgman's report, which has already been mentioned, we have a very illuminating account by Prof. Lorentz of the application of the electron theory to metals, a paper by Dr. Rosenhain on the internal structure of alloys, and an account written by the late Prof. Kamerlingh Onnes of his work on supra-conductors.

The mention of the name of this great pioneer, whose death we had to deplore some time ago, brings me to the one complaint which I have to urge. The present volume does not record the proceedings of the conference held last year, but of its predecessor of 1924. Even admitting that the work of editing a volume of this kind is not light, and that it is not the easiest of tasks to extract corrected proofs from distinguished men, the interval of three years between the meeting of a conference and the publication of its report seems unnecessarily long. It would be a real benefit to science if these reports, which are always looked forward to eagerly, could be published at any rate within twelve months of the date of the conference. It says much for the quality of the work contained in the present volume that it has lost so little interest by the unfortunate delay.

J. A. CROWTHER.

Nature of Cytoplasmic Inclusions.

Symbionticism and the Origin of Species. By Prof. Ivan E. Wallin. Pp. xi + 171 + 4 plates. (London: Baillière, Tindall and Cox, 1927.) 13*s.* 6*d.* net.

IT is now at least eight years since there have been any flutterings in the cytological dovecot. Everyone had settled down to a cell containing a nucleus with chromosomes, karyoplasm, karyosome, and plasmosome, and a cytoplasm with centrosome, Golgi bodies, and mitochondria. If there were malcontents, they had been silenced by the shock effect of the vast and ever-increasing international literature on the cytoplasmic inclusions. In the field concerned with the intra-nuclear bodies, the chromosomes have attained respectability even in the views of those physiologists who cannot understand such a simple thing as the chromosome theory.

Now in this last year there have been ripples in the hitherto calm waters. First, there has been the re-blooming of the Merseyside cytological plant, under the care of Prof. Charles Walker, who, to the admiration of several chemists and at least one palæontologist, has, so to speak, demonstrated, with the aid of a tin of condensed milk and some water, that there is no such thing as a cow (*Proc. Roy. Soc.*, vol. 101, B, 712). Secondly, Dr. Parat has discovered that Golgi, Cajal, Rio Hortega, E. B. Wilson, Da Fano, Ludford, Bowen, Hirschler, Hyman, Doncaster, Voinov, Nassonow, and many

other cytologists and histologists, have mistaken mitochondrial bodies ('lepidosomes') for the true Golgi bodies, and that Dr. Parat's veritable cell vacuole is the true Golgi apparatus; and we have the word of the distinguished human anatomist, Dr. Woollard ("Recent Advances in Anatomy"), that Dr. Parat is correct!

Lastly, we note the issue of the book under review. Dr. Wallin, professor of anatomy in the University of Colorado School of Medicine, does not cry 'artefact' at us, as does Prof. C. Walker, nor does he mention the 'vacuome' of Parat especially —he merely asks us to believe that the mitochondria (and the Golgi bodies possibly also, being modified mitochondria) are bacteria ('symbiotes'). The origin of species has taken place largely owing to the activity of these bacterial symbiotes, and the process is called 'symbionticism,' a new and horrid word. Dr. Wallin, unlike Dr. Walker, is prepared and ready to allow us any cytoplasmic inclusions we like, just so long as we do not forget that they are bacteria. He does not mind whether Golgi's Golgi apparatus is the real Golgi apparatus, or whether Dr. Parat's rival Golgi apparatus is the real Golgi apparatus.

Seriously, however, Dr. Wallin finds that mitochondria may be minute spheres or rods (like bacteria), may stain in fuchsin and such dyes (like bacteria), may divide by binary fission (like bacteria), may grow on media (like bacteria), and, finally, that all stages in the establishment of 'symbionticism' may be found in such organs as cockroach eggs, plant roots, and cephalopod light organs, to mention but a few. 'Symbionticism' is the key, according to Dr. Wallin, to the diversity of animal life.

Now it may be said at once that it is not easy to get a definition of a bacterium which would not equally well apply to a mitochondrion—at least the reviewer has not met the bacteriologist who could give a satisfactory and discriminating definition. This is the strength of Dr. Wallin's position. On the other hand, it is possible for the cytologist to give a definition of a mitochondrion which may exclude all bacteria. For example—a mitochondrion is a minute sheathless intra-cellular body never containing chromatinic particles, and capable of fusing with other mitochondria to form structures such as the uninterrupted tail of a spermatozoon.

Now, Dobell showed years ago that in large bacteria chromatic particles exist. No mitochondria large or small ever contain such particles. Then, too, no bacteria are known to fuse into a mass to form one long structure, like a sperm tail sheath. Dr. Wallin will find that the field of spermatogenesis alone will provide facts which make his position untenable. We believe that the case he makes for the growth of mitochondria on nutrient media is unsatisfactory, though even if the evidence had been complete, this would not convince the reviewer that mitochondria are necessarily bacteria.

The similarity between the techniques for staining bacteria and Golgi bodies and mitochondria can be admitted if at the same time it be pointed out to Dr. Wallin that there never was a case where the two types of structures (symbiotic or parasitic bacteria and mitochondria) could not be differentiated easily by current techniques. No one has ever described any sort of sheath on mitochondria, and the latter are more fragile than the general run of bacteria. The similarity in size and shape between bacteria and mitochondria means little. The case Dr. Wallin tries to make for a similarity of chemical constitution between bacteria and mitochondria is completely unconvincing.

J. BRONTË GATENBY.

The Activated Sludge Process of Sewage Treatment.

The Activated Sludge Process. By Arthur J. Martin. (Reconstructive Technical Series.) Pp. xiv + 415 + 37 plates. (London: Macdonald and Evans, 1927.) 30*s.* net.

THIS book may be described as an amplification and bringing up-to-date of the paper read by Mr. Martin before the Institution of Civil Engineers a few years ago, in which he brought together established facts and results contained in a great number of scattered papers dealing with the subject of the activated sludge process.

Chap. i. details the early work on the forced aeration of filters and various methods of aeration of sewage in tanks, including the Lawrence and Fowler experiments. Chap. ii. is concerned with the experiments of Arden and Lockett, many extensive extracts being given from the papers by these workers. Full-sized working units at Withington and Davyhulme are described in Chap. iii., with drawings and photographs, analyses, and useful data respecting air consumption and volume of sewage treated.

The diffused air system is fully dealt with in Chap. iv., a number of British works being fully described, with plans and sections: a good photograph is given in this chapter, showing an aerial

view of the Coventry works. The next three chapters are devoted to the subject of mechanical agitation; the Sheffield, simplex, spiral flow, and others being described at some length.

A short chapter—Chap. viii.—records the progress the process has made in England, as shown in the annual reports of the Ministry of Health, whilst the next chapter deals with the process in America and Canada, the Milwaukee, Chicago, Houston, Indianapolis, and other plants being fully described and illustrated with plans and photographs.

Chaps. x. and xi. deal respectively with the theory and the requirements of the process, and it may be questioned whether, all things considered, these two chapters would not come in more suitably at an earlier stage. In Chap. x. the sensitiveness of the process to changes in the character of the sewage, as, for example, those brought about by influxes of certain trade wastes, is emphasised. In the latter chapter, the essential requirements of the process, namely, oxygen, suitably conditioned sludge, and effective circulation of the sludge and liquid, are carefully described, frequent quotations from various well-known authorities being made.

Chaps. xii. to xiv. are concerned with need for preliminary treatment, alternative modes of working, and diffusers; whilst Chap. xv. deals with the important question of design of tanks, the Clifford inlet being described and illustrated. The next three chapters treat of air compression, loss of pressure in air mains, and appliances for mechanical agitation. Power required for agitation receives notice in a short chapter (xix.) of three pages.

The rather controversial question of comparison of methods of agitation has eleven pages devoted to it in Chap. x., the advantages and drawbacks of various methods being carefully discussed. The author states that the air-blowing method, being first in the field, has naturally received more attention than mechanical agitation.

Chap. xx. contains eleven pages descriptive of a combination of methods, Imhoff's Essen-Rellinghausen experiments on the use of diffused air in conjunction with mechanical agitation being described and illustrated, together with the Kettwig submerged contact aerator, in which the aerator consists of brushwood, air being supplied by a moving pipe.

Chaps. xxii. and xxvi. deal with position and outlook, cost of process, reduction of cost of process, factors affecting cost of power, and possible lines of advance.

The bugbear of sludge disposal is very fully and usefully discussed in Chap. xxvii., 34 pages being given to this most important question. The author points out that the bulk of activated sludge—owing to its high water-content—is frequently more than 1 per cent., and sometimes as great as 6 per cent. of that of the sewage from which it originates. He considers that if it is found practicable to apply activated sludge direct to land in its wet state, one of the chief obstacles to the adoption of this process of sewage treatment will have been removed.

The final short chapter of six pages deals with latest developments in the process. Six appendices follow, and an exceptionally complete, useful, and well-arranged bibliography relating to the literature of the activated sludge process.

A list of authors cited and a comprehensive index complete the book.

The book is well written and illustrated, and the printing is good. The author may fairly claim to have accomplished what he set out to achieve, namely, "to present the leading opinions on both sides, and so far as possible, in the words of those responsible for them." The labour involved in bringing together in readable form the salient facts and features of the activated sludge process from the voluminous literature relating thereto must have been considerable, and Mr. Martin's book should prove most useful to engineers and others interested in sewage treatment.

G. BERTRAM KERSHAW.

A Ruthless Republic.

The Life of the White Ant. By Maurice Maeterlinck. Translated by Alfred Sutro. Pp. 213. (London: George Allen and Unwin, Ltd., 1927.) 6*s*. net.

IN taking up any work on natural history by Maurice Maeterlinck, we know that we may expect to find a picturesque compilation of facts for the most part well authenticated, recounted in an agreeable style, and diversified by comments of a moralising character which, though not always convincing, are generally not without interest. The present book is in these respects true to type. The author has been to the best sources for his facts; his philosophical deductions bear the impress of a mind which, if somewhat uncritical in method, is yet sound in its estimate of the importance of human life and destiny.

The systematics of the remarkable group of insects here dealt with are but lightly touched upon. The reader will find nothing to replace the treatment of morphological detail which is the concern of ordinary text-books. It is the constitution,

economy, and polity of the termitarium, the extraordinary differentiation of the various descendants of a single pair, the pitiless subordination of the apparent well-being of the individual to that of the community, that principally engage the author's attention. A matter of which he treats at considerable length is the symbiotic relation between termites and their intestinal protozoa, the recognition of which we owe to the recent investigations of L. R. Cleveland.

The architecture of the common habitation is briefly described, and sketches are given of the distinctive characters and behaviour of the workers, soldiers, and royal couple. But the author's speculations on the origin and development of the various instincts that combine to make up the life of the termite society are vitiated by his persistent attempts to attribute foresight and intelligence to its constituent members. The key to the problem is to be found, no doubt, in the comparison of the more or less advanced stages of elaboration reached by the development of different species, under the influence of natural selection. Considerations of this sort, however, do not appeal to M. Maeterlinck, who appears to prefer to have recourse to the supposed "intelligence and will" of the termites. Thus, on the subject of their nutrition he asks, "Why not recognise that they may themselves have found it more convenient, preferable, to install digestive protozoa in their own bodies, so as to be able to give up vegetable mould and eat whatever they choose?" Then again, in reference to the mushroom-cultivating species, he says:

"The termites must have noticed that such mushrooms provided a far richer, more certain and more directly assimilable food than vegetable mould or waste wood, and possessed the additional advantage of helping them to get rid of the embarrassing protozoa whose weight was becoming so oppressive. Thenceforward they proceeded systematically to cultivate these cryptogams."

It is true that M. Maeterlinck adds, "Evidently, or at least probably, all this is due merely to chance"; but his reference in the same passage to the method of cultivation in the neighbourhood of Paris shows that his attribution of conscious ingenuity and method to the termite is deliberate and intentional. It seems, in fact, from this place and from many allusions to the *anima mundi*, that he would not be disinclined to apply to the 'white ants' what Vergil says about the bees:

"his quidam signis atque haec exempla secuti
esse apibus partem divinae mentis et haustus
aetherios dixere."

F. A. D.

Our Bookshelf.

An Introduction to the Scientific Study of the Soil. By Prof. Norman M. Comber. Pp. 192. (London: Edward Arnold and Co., 1927.) 7*s.* 6*d.* net.

THE great advance in our knowledge of soil physics and chemistry during recent years has been accompanied by a flood of literature which renders it increasingly difficult for any worker to obtain a comprehensive view of the subject without the expenditure of undue time and labour. Prof. Comber is therefore the more to be congratulated, in that he has succeeded in presenting the salient features of the subject in such a way that not only students (for whom the book is primarily intended) but also advanced research workers will find much illumination and assistance therefrom. His exposition is masterly, a few words conveying the essentials of each point without burdening the reader with details, which can be found when necessary in the original papers, to which an adequate bibliography is provided. One striking feature is the simple explanation of common phenomena which are not often thought about, as, for example, why seeds fail to grow if planted too deeply.

After dealing briefly with the relations between the soil and the plant, the origin and development of different soils are described under the heading "soil genetics," and then the components and attributes of soils are treated individually in more detail. This leads up to an account of various bases of soil classification, from the agricultural and the scientific viewpoints, special attention being given to the work of the Russian school of investigators and to the United States work on soil profiles. Various experimental methods for comparison of the effect of different types of soil treatment in the laboratory and the field are outlined, with indications of their relative value. An unusual feature is introduced in the form of practical suggestions to the student as to the best methods of utilising the literature of the subject, a matter which seems simple at first sight but is apt to involve the inexperienced in a welter of information which obscures the end sought. This book, with its clarity of concentration of a complicated subject, should prove of the utmost value to all who are working on the soil, whether from the biological, chemical, or physical point of view.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By Prof. J. A. Fleming. Fourth edition, revised and extended. Pp. xv+422. (London: Constable and Co., Ltd., 1927.) 21*s.* net.

THE addition of a new chapter to this book has greatly increased its usefulness. The enormous improvements in the design and manufacture of submarine cables, and the advances made in the construction of telephone and telegraph cables, make some account of them essential to the student. The use of powdered iron instead of iron wire in the cores of 'loading' coils has practically

eliminated eddy current loss without lowering appreciably the permeability of the core. The extension of the usefulness of the cable by means of 'phantom' circuits can only be obtained by almost perfect balancing of the various circuits. It was discovered in American research laboratories that an alloy of nickel and iron containing more than 30 per cent. of nickel has remarkable magnetic properties. Permalloy has a composition of nearly 80 per cent. of nickel and 20 per cent. of iron. At vanishingly small magnetising forces permalloy may have a permeability of 13,000, which is more than thirty times as large as that of the best soft iron. Permalloy may even be saturated when subjected to the earth's magnetic field.

It is found that when a submarine cable is suitably covered with permalloy tape, the speed of transmission of the messages can be increased ten times. A brief mention is made of the structure and mode of using thermionic repeaters, the use of which has greatly increased the range of telephony and greatly reduced the cost of the conductors. The development of carrier wave multiple telephony is also described. By its means several independent conversations can be conducted simultaneously on one line. It is satisfactory to note that practically all these inventions are the immediate outcome of the application of theory. To the student especially this book will be of great value.

Die seltenen Erden vom Standpunkte des Atombaues. Von Prof. Dr. Georg v. Hevesy. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Heft 5.) Pp. viii + 140. (Berlin: Julius Springer, 1927.) 9 gold marks.

THE discovery by Johann Gadolin in 1794 of the mineral gadolinite opened up a new and difficult field of investigation, which has had an important bearing on the theory of atomic structure. The problem of fitting the rare-earth elements into the periodic system was only partly solved when Moseley's work revealed the total number as well as the positions of members of the cluster. Hevesy shows how Bohr's theory of atomic structure provides a key to their mysterious behaviour, and the well-known fact that, chemically, yttrium lies in the midst of its higher homologues becomes intelligible; for whilst the valency-electrons of tervalent lanthanum are more remote from the nucleus than those of yttrium, and are therefore less firmly bound, other conditions prevail in higher members, where valency-electrons lie at a deeper quantum level.

Amongst other physical properties the paramagnetism of ions is discussed at length, and is shown to exist only where the distribution of valency-electrons is anomalous, but the latter are unusually deep-seated between cerium and lutecium. This is held to account both for chemical similarities and chemical irregularities in the cluster. Now since no satisfactory data are as yet available of ionisation potentials with which to judge the firmness with which these electrons are held, one has to draw conclusions from the molecular volumes of analogous compounds. Though apparently irregular, the results are in agreement with the requirements of Bohr's distribution. Thus a steep rise in value in passing from scandium to lanthanum is followed by a gentle fall from lanthanum to lutecium.

The second part contains a useful account of the chemical properties of compounds and concludes with a historical survey of the subject.

Directing Mental Energy. By Dr. Francis Aveling. Pp. x+276. (London: University of London Press, Ltd., 1927.) 8*s.* 6*d.* net.

THIS is a peculiarly constructed book. The author seeks to show how we may economise our expenditure of energy, of which we possess only a limited stock, as a partial solution of the problem 'How to make the most out of life'; as if a conscientious application of the proverbial injunction 'to take care of the pence' were an important secret of happiness. Yet, fundamentally, Dr. Aveling is more concerned with the problem of spending wisely than with the rather negative emphasis on economy and on the avoidance of waste from which he starts.

The title and the introduction suggest a much more profound and philosophical treatise than the author has given us. Consequently, in parts, the treatment seems somewhat inadequate; some of the topics, especially those on industrial and vocational psychology, are dealt with too broadly for a work of this kind. Dr. Aveling, however, sees unity in the diversity of our daily life and invokes the laws of energy to explain it. Even such a spontaneous expression of human impulses as is found in play is regarded as having its 'why and wherefore' in the constancy of human energy. The book is decidedly interesting, though the author's thesis will not be acceptable to all psychologists.

Mexican Architecture of the Vice-Regal Period. By Walter H. Kilham. Pp. 223+84 plates. (New York and London: Longmans, Green and Co., Ltd., 1927.) 21*s.* net.

HISPANO-AMERICAN architecture is not likely to be a subject with which very many European readers are familiar. It is, however, well worth study, on account of its innate beauty and form. Its period of development extends from the middle of the sixteenth century to the beginning of the nineteenth, when Spanish domination came to an end. Mexican architecture in its main lines followed that of Spain at a time when the Renaissance style was developing in the mother country. It presents, however, a course of independent development of its own, which comes out in many features, but especially in the use of coloured tiles. Of its peculiarities, many are due to the employment of native workmen, Indians, who themselves had an architectural tradition behind them, and considerable artistic taste of their own. It is this which gives Spanish-American architecture an individual interest as a subject of study. Mr. Kilham's informative sketch of its history is clear in its description and exceedingly well illustrated.

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.*]

The Nature and Function of Golgi Bodies.

IN view of Prof. Charles Walker's letter in NATURE of Jan. 21 on the nature and function of Golgi bodies, perhaps I may be allowed to summarise, briefly, the reasons why most cytologists have come to regard the Golgi apparatus as a definite cytoplasmic structure:

(1) The Golgi apparatus can be seen in certain living cells, for example, spermatocytes of Helix (Platner, Murray).

(2) A positive picture of the apparatus can be obtained by the silver and osmic methods (Cajal and Kopsch, and their numerous modifications); also a negative picture results when good cytoplasmic fixatives are employed. Anyone can prove this by trying the osmic and silver methods with cells of the epididymis, or pancreas of the mouse, and comparing the results with material fixed in osmic acid, and counterstained with a plasma stain. In suitable osmic preparations the mitochondria can also be counterstained, and then appear the same as in the living cell, so the argument that cell structure has been distorted by the technique is untenable. It has been shown by Karpova that the Golgi bodies in the spermatocyte of Helix can be stained with Sudan III. after the bichromate treatment of Ciaccio, and Weiner has been able to demonstrate the apparatus by the same method in epithelial cells of the intestine.

(3) The Golgi apparatus has a characteristic form in different types of cells; for example, in most neurones it is a network, while in fibroblasts it forms a compact cluster around the sphere.

(4) It has been shown by a large number of workers (see the reviews of Bowen, *Anat. Rec.*, vol. 32, 1926, and Jacobs, *Ergeb. d. Biol.*, vol. 2, 1927) that there is a definite correlation between the form of the Golgi apparatus and the functional activity of the cell. Thus the form of the apparatus varies during secretory activity in gland cells. In neurones it is altered as the result of injury (Cajal, Penfield); while phosphorus poisoning induces well-marked changes in cells of the pancreas (Cowdry). During gametogenesis, also, it undergoes characteristic changes (Gatenby, Bowen, Brambell).

(5) The secretion granules of gland cells arise in relationship with the Golgi apparatus. Nassonov and Makarov have shown that acid dyes such as trypan blue when injected subcutaneously collect in liver and kidney cells in that part of the cytoplasm where the Golgi apparatus is situated. The droplets of dye accumulate, therefore, in the region of the Golgi apparatus, so the apparatus cannot be a mere condensation of lipoids around droplets as Walker has suggested.

Prof. Walker's argument is based upon a fallacy, that things which look alike are necessarily the same. Every elementary student of physiology knows that models can be set up to imitate amœboid movement, cell division, and growth (artificial osmotic membrane experiments), while cell-like structures with nuclei can be imitated with gelatine solutions. Does this disprove the reality of these vital phenomena? Since Prof. Walker has produced artificial structures, which he says look like Golgi bodies, this no more disproves the existence of the Golgi apparatus in living cells than the production of artificial cells with nuclei disproves the reality of cell structure. Prof. Walker's work seems rather to confirm the view held by most cytologists that the Golgi apparatus is of a lipoidal nature.

R. J. LUDFORD.

Laboratory of the Imperial Cancer Research Fund,
8-11 Queen Square, London, W.C.1,
Jan. 21.

The Spectrum of the Corona.

A CORRESPONDENCE, which may be important, has been found between the 'unknown' spectral lines of the solar corona and the spectrum of argon. It has been found possible to connect about two-thirds of the coronal lines given by Campbell and Moore with the argon lines and terms in Meissner's recent investigation.

There are 18 lines directly identified. The lines in the argon spectrum immediately before and after the selected one are, in each case, well removed from the selected line, compared to the discrepancy between the coronal and the argon wave-numbers. In any case this latter discrepancy is within the accuracy to which the coronal lines are known.

Space does not permit of giving the complete tables, but a few typical examples will be quoted:

The average disagreement is 2 wave numbers; the maximum is 5 (allowed only in the cases where the determination of the wave-length is correspondingly uncertain) and there are half-a-dozen lines where the agreement is accurate within one wave-number. On the other hand, the average distance to the nearest line in the argon spectrum is 30 wave-numbers. For example, the coronal line of wave-number 27443 has, corresponding to it, an argon line, 27441. The argon lines closest by, and to either side, are 27391 and 27507. The selected argon line has the designation $1s_4 - 4p_8$. Consider the two coronal lines of wave-numbers 19533 and 17860. It was recognised that the difference in the wave-numbers was the same as the interval between the $2p_8$ and the $2p_3$ terms in argon, and the argon wave-numbers given by $2p_8 - 6s_1'''$, and by $2p_3 - 6s_1'''$ are these two coronal wave-numbers to within 1 wave-number.

The lines directly identified include most of the strong lines of the corona. Ten other coronal lines are found to be expressible as combinations of Meissner's term values. Thus a line of wave-number 24468 may be compared with the wave-number 24470 given by the combination $1S_3 - 4d'_4$. A coronal line at wave-number 18852 is given by $2p_4 - 9s_4 = 18852{\cdot}58$ and by $2p_5 - 7s_1'' = 18852{\cdot}17$. This line, $\lambda 5302{\cdot}9$, is the brightest line in the coronal spectrum; and the fact that its wave-number is given quite accurately by two different combinations of terms (that is, by two different possible changes in the state of the radiating centre), may be connected with this fact.

Because of the presence of Ca II in extremely high levels of the chromosphere, it was thought that the coronal lines might be attributed to this substance or to Ca III as suggested by Pannekoek. However, a comparison with J. A. Anderson's tables of the calcium spectra gave no very suggestive agreement.

The implication that argon exists in the sun is not borne out by other solar observations; but it is to be remembered that a given substance may be abundantly present in the sun, and yet because the external conditions do not bear a certain definite relation to its ionisation potential—as required by the Saha theory—the spectrum may not appear at all. It is not beyond possibility that conditions of temperature

and pressure in certain regions of the corona are favourable not only for the production of the lines of a given element but also for the appearance of groups of lines which are not given by ordinary laboratory methods of excitation.

A more detailed presentation will appear soon in the *Astrophysical Journal*. IRA M. FREEMAN.

Ryerson Physical Laboratory,
University of Chicago.
Jan. 5.

A Simple Rainfall Law.

I HAVE recently prepared statistics giving the maximum total rain falling on any n consecutive days, for selected stations in Ceylon, and over certain periods. These figures, with a discussion, are being published as a paper, "Heavy Rainfall in Ceylon," in the *Transactions of the Engineering Association of Ceylon* for 1927.

In the course of this investigation I discovered a very simple law, which Ceylon rainfall seems to follow very closely, but which, so far as I am aware, has not been pointed out elsewhere.

Consider the maximum value of the total rain falling in n consecutive days during any one year. Let R represent the mean of a number of such values for different years; then, if this mean is taken over a sufficient number of years, we have

$$R = Qn^K,$$

where Q and K are constants for any particular station and period of years, and n is small. This formula holds with remarkable accuracy, when the means are taken over, say, 40 years or more.

In the table below, figures are given for four stations. The first row for each station gives R, the actual mean yearly maximum rainfall, in inches, extracted from the daily records of that station.

STATION.	$n=$	1	2	3	4	5	6	7	8	9	10	Q	K
Avissawella (47 years)	Actual mean maxima	5·89	8·16	9·66	11·20	12·59	13·94	15·17	16·13	17·15	18·09	..	..
	Theoretical mean maxima, $=Qn^K$	5·68	8·05	9·87	11·40	12·75	13·97	15·10	16·15	17·12	18·06	5·68	0·502
	Percentage excess of actual	+3·6	+1·4	−2·1	−1·8	−1·3	−0·2	+0·5	−0·1	+0·2	+0·2	..	..
Haldummulla (40 years)	Actual mean maxima	4·64	6·46	7·97	9·26	10·46	11·46	12·42	13·10	14·08	14·84	..	..
	Theoretical mean maxima, $=Qn^K$	4·58	6·52	8·02	9·29	10·40	11·42	12·35	13·23	14·04	14·83	4·58	0·510
	Percentage excess of actual	+1·3	−0·9	−0·6	−0·3	+0·6	+0·3	+0·6	−1·0	+0·3	+0·1	..	..
St. Martin's (37 years)	Actual mean maxima	10·34	15·38	19·16	21·54	24·31	27·00	29·21	31·34	33·45	34·97	..	..
	Theoretical mean maxima, $=Qn^K$	10·54	15·15	18·74	21·78	24·47	26·92	29·17	31·30	33·27	35·16	10·54	0·523
	Percentage excess of actual	−2·0	+1·5	+2·3	−1·1	−0·7	+0·3	+0·1	+0·1	+0·5	−0·5	..	..
Jaffna (56 years)	Actual mean maxima	5·17	6·95	7·93	8·78	9·53	10·24	10·93	11·42	11·88	12·45	..	..
	Theoretical mean maxima, $=Qn^K$	5·24	6·79	7·91	8·81	9·58	10·26	10·87	11·42	11·94	12·42	5·24	0·375
	Percentage excess of actual	−1·4	+2·3	+0·2	−0·3	−0·5	−0·2	+0·5	0·0	−0·5	+0·2	..	..

The columns headed Q and K give the constants deduced from these straight lines, while the second row for each station gives values of Qn^K, computed from these constants. The third row gives the percentage excess of the first row over the second, and it will be seen that the agreement is remarkably close.

As the stations examined represent a considerable diversity of rainfall types, depressional, north-east monsoon, south-west monsoon, and diurnal local circulation, it seems probable that this is a general law, universally applicable, in which case it affords a means of classifying rainfall by two numbers only. Such a simple numerical classification may be of value in regional studies of precipitation.

I have submitted a paper on this subject to the *Ceylon Journal of Science*, and this will appear in the next issue of Section E, while further investigations on the variations of K and Q, over Ceylon, will be undertaken. H. JAMESON.

Colombo Observatory,
Dec. 27.

The Two Calories.

I HAVE read with appreciation Mr. Marks's letter in NATURE of Jan. 14. May I recall that fifty-seven years ago Thomas Muir, the mathematician (now Sir Thomas Muir), suggested the names therm and kilotherm for them (see NATURE, vol. 1, p. 606). Since then the Gas Companies have appropriated the name therm and defined it as 100,000 British Thermal Units. It seems to me that from the scientific, the engineering, and the practical points of view, the best units for heat are the kilowatt-hour, its multiples and sub-multiples.

ALEXANDER RUSSELL.

Faraday House,
Southampton Row, W.C.1.

THE confusion between the two calories referred to by Mr. Marks in NATURE of Jan. 14 would be made worse by his suggestion that the kilogram calorie should be written as Kalorie, since it could then be confused with the so-called Ostwald calorie—a unit which should never be used and is now obsolete, because the latter is denoted by K. The matter of differentiating between the gram and kilogram calories was considered by the Bureau of Chemical Abstracts some little time ago, and the chairman of the board, Prof. J. C. Philip, informs me that it was decided to use 'g. cal.' and 'k. cal.' for the two units. It is highly desirable that this method should be generally adopted, since much confusion and even error is undoubtedly caused by the use of 'cal.' and 'Cal.' The question of the unit calorie, whether 15° or 20°, etc., adds a further source of confusion to very accurate work, and when this is known it may be stated as a suffix, say g. cal.$_{15°}$, as is also done by the Bureau of Chemical Abstracts.

The whole matter of physico-chemical symbols was considered some time ago by a small committee of the Chemical Society, of which I was a member, and some trouble was taken with it. The results, however, which were handed over to some international body or other, have disappeared without trace.

J. R. PARTINGTON.

Kingsbury Close,
London, N.W.9.

A Proposed Biological Flora of Britain.

IN the preface to the first edition of the "Students' Flora," published in 1870, Sir Joseph Hooker expressed the hope of being able to undertake a companion volume in which "the physiological and morphological observations" on British species should be recorded. Ever since that time this idea has been in the minds of botanists, but so far no serious attempt has been made to bring the project to fruition.

Such aut-ecological data are of great value, not only

for their own sake, but also for the progress of the study of plant communities, which is greatly hampered by the lack of information respecting the life-histories and biotic relations of their constituent species. Further, until such data are available, it is useless to attempt to unravel the complex tangle of factors involved in the phenomenon of competition.

Much relevant information is scattered through the literature but is comparatively inaccessible; much, too, is known to field naturalists, but perishes with them. The collection of the published data, and such original observations as are available, will not only be valuable in itself, but will also provide the surest means of bringing to the notice of students the many lacunæ that require to be filled.

The council of the British Ecological Society has had the matter under consideration, and at the annual meeting on Jan. 7, the Society decided to undertake the publication of a British biological flora which should embody the available data regarding the biology and ecology of the native and naturalised British species.

The writer, who has been making observations and collecting data of this character with reference to British woodland species for several years past, has undertaken the preparation and editing of the work, but it is manifestly a task that can only be successfully accomplished by the active co-operation of botanists, professional and amateur alike, throughout the country.

A schedule indicating the scope of the projected work has been prepared by the writer and will be sent to anyone willing to assist.

E. J. SALISBURY
(President, British Ecological Society).
University College, London.

Polarisation of Radio Waves.

IN some recent work on this subject carried out for the Radio Research Board, the following interesting results have been obtained in connexion with the propagation of long waves (14,350 metres).

In the course of simultaneous observations over a period from one hour before until one hour after sunrise of the same transmission from St. Assise by two stations, Slough and Aberdeen, roughly 400 and 1000 km. from it and approximately on the same great circle, it has been found that in the period preceding sunrise the wave arriving at the nearer station is plane polarised, with its plane of polarisation rotated in a clockwise direction when looking in the direction of propagation, whereas at the more distant station the rotation is anti-clockwise. By the time of sunrise both these abnormal polarisations have gradually decreased and disappeared, and in some cases at the nearer station the space wave appears to have entirely vanished also. About half an hour later, however, the space wave reappears at the nearer station, but this time with left-handed polarisation.

This persists with varying intensity throughout the day, again disappearing about 15.00 G.M.T., when the right-handed polarisation returns for the night.

It has also been shown that the wave reaching the far station has started from the transmitter at practically the same angle of elevation as the wave to the near station, and that its downcoming angle at the far station is comparatively steep. Internal evidence is strongly against the idea of a twice-reflected wave, mainly because the variations of direction and intensity observed are too great to fit in with the roughly known values of the reflecting power of the layer for a single reflection; and there seems a strong probability that we are here dealing with some form of doubly refracted ray of which one element is being received at each station. The direction of transmission makes an angle of 15° with the magnetic meridian, but owing to the high value of the magnetic dip in these latitudes it is difficult to link up these results with the theoretical formulæ. Further experiments on the subject are in progress.

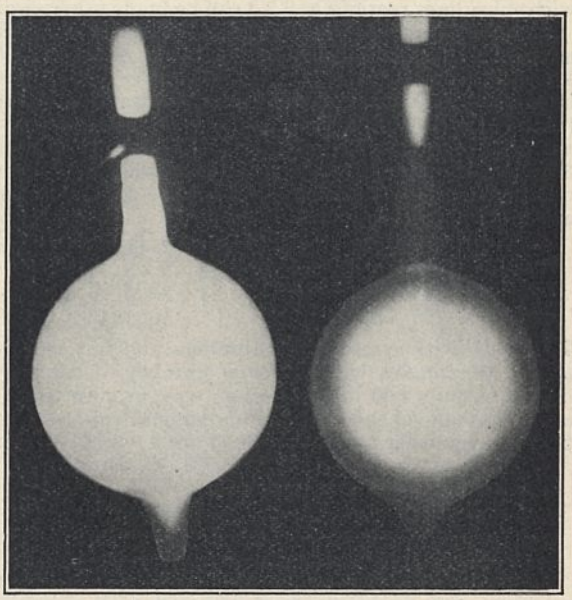
J. HOLLINGWORTH.
R. NAISMITH.

Radio Research Station,
Ditton Park,
Langley, Bucks,
Jan. 13.

A New Form of the High Frequency Electric Discharge.

RECENTLY, we have conducted experiments on the electric discharge through gases at very low pressures with alternating potentials of about 4×10^7 cycles per sec. (7 metre wave). Results were obtained with mercury at pressures of the order of 10^{-3} mm. in a bulb 20 cm. diameter with neck of 2 cm. diameter, and external copper-foil wrappings as electrodes on the neck, and showed that the discharge could take two distinct forms as shown in the accompanying photographs.

In the first type of discharge (Fig. 1, A) the discharge



A B

FIG. 1.

was projected as a visible streamer into the bulb below, which was almost completely filled with the glow. In the second case, with lower exciting power, the discharge (Fig. 1, B) took the form of a spherical glow of uniform luminosity separated from the walls by a dark space. A considerable portion of the neck of the bulb was completely dark, and discharges of the ball type could be maintained with no luminous effects at all in the side tube.

The behaviour of the two types of discharge when subjected to magnetic fields, showed quite diverse effects, and after many experiments with different gases, it was concluded that the bulb discharge was maintained (once initiated) by the stray alternating electric field from the electrodes which is projected down the neck into the bulb.

This new type of electric discharge is analogous

to a uniform electron and positive ion high temperature enclosure, and preliminary results indicate that by its means many spectral and chemical problems may be attacked under conditions not previously realisable. The conditions of excitation are probably similar to those existing in the outer atmosphere of the sun.

JAMES TAYLOR.
WILFRID TAYLOR.

Trinity College, Cambridge.
Jan. 12.

Subsidiary Rectangles as applied to the Formation of Magic Squares.

IN the issue of NATURE of Jan. 14 I gave the smallest 'associated' rectangle, consisting of 3 rows which has the property of the diagonals one way summing to the same as the rows. This was with non-consecutive numbers. The smallest associated rectangle with consecutive numbers is :

18	20	24	9	5	12	25	7	6
2	1	15	17	14	11	13	27	26
22	21	3	16	23	19	4	8	10

126×42

In this associated rectangle, the rows and the diagonals from left to right sum to 126, the columns to 42. But as with order 18 rectangles 6×3 the diagonal requirement is not necessary as associated pandiagonals with subsidiary rectangles 9×3 can be made otherwise.

This diagonal requirement is necessary for all associated pandiagonals with subsidiary rectangles of 3 rows, except as above, when the number of columns in the rectangle is a multiple of the number of rows (three), such as 6×3, 9×3, etc. With pandiagonals *not associated* consisting of subsidiary rectangles of 3 rows it is still necessary with all rectangles with an odd number of columns such as 7×3, 5×3, etc. I give an example of each :

14	17	15	12	4	9	6
1	3	2	11	21	19	20
18	13	16	10	8	5	7

77×33

14	12	11	2	1	
6	9	8	7	10	
4	3	5	15	13	

40×24

These are with consecutive numbers and not associated. Rectangles with an even number of columns do not require the diagonals one way to sum to the same amount as the rows. Pandiagonal squares can be made by other methods. Such are 4×3, 8×3, etc.

J. C. BURNETT.

Barkston, Grantham, Lincs.

Production of Bubbles of Selenium.

IT may be of interest to record that bubbles of selenium can be blown from the end of a suitably shaped glass tube, after dipping it momentarily into the molten 'metal.'

I find it best to use for this purpose a glass tube which has an internal diameter of about an eighth of an inch, and to bell out slightly the extremity which is to be dipped into the molten selenium.

The temperature of the selenium should be just below that at which it gives off a faint cloud of condensing vapour. By paying attention to these conditions, I have succeeded in blowing bubbles, usually somewhat irregular sausage-shaped things, as long as five centimetres, and three centimetres in diameter at the largest part.

The walls of these bubbles are extremely thin and show well the beautiful rich colour of selenium when viewed by transmitted light. The method also affords a simple means of obtaining small thin flakes of selenium for various experimental purposes.

Great care is required to regulate the air pressure, which only seems to be possible by blowing with the mouth. Success is obtained only by choosing the right moment when the selenium is so far cooled as to be highly viscous.

An interesting property of these bubbles is that if, even after twenty-four hours, they are brought into very light contact with one another, they seize violently together and cannot be again separated.

CHARLES E. S. PHILLIPS.

Castle House, Shooter's Hill, S.E.18,
Jan. 19.

Inflammable Gas from Plants.

IN reply to Prof. Findlay's request in NATURE of Jan. 14, for information concerning the exhalation of an inflammable gas from the Fraxinella, I have much pleasure in communicating the following items :

(1) From page 336 of vol. 2 of "Chemical Essays," by Dr. R. Watson, Third Edition (London, 1784):

"*Fraxinella* is a very odorous plant ; when in full blossom, the air which surrounds it in a still night may be inflamed by the approach of a lighted candle ; does this inflammability proceed from an inflammable air, which is exhaled by the plant, or from some of the finer particles of the *oil* of the plant, being *dissolved* in the common air of the atmosphere."

(2) From page 107 of vol. 1 of "Elementary Lectures on Chemistry and Natural History." Translated from the French of M. Fourcroy (Edinburgh, 1785):

"The atmosphere which floats round the fraxinella is inflammable from the admixture of some essential oil : and M. Scheele is of opinion that every inflammable air is composed of a very subtile oil."

(3) From "Webster's New International Dictionary of the English Language" (London, 1919):

"Fraxinella. A perennial rutaceous herb (*Dictamnus albus*) with pinnate leaves and white flowers, which exhale an inflammable vapour in hot weather —often called 'gas plant.'"

FREDK. C. SHORT.

The Tower House,
Sutton Road, Walsall, Staffs, Jan. 14.

'Self-Adaptation' in Biology.

"PARACELSUS, the first materialist, proclaimed man to be a chemical compound" (NATURE, Jan. 7, p. 14). No doubt Dr. Fournier d'Albe can give references to confirm this statement. In the meantime may I quote the following detached paragraphs ?

"The life of man is an astral effluvium or a balsamic impression, a heavenly and invisible fire, an enclosed essence of spirit. . . ." ("De Natura Rerum," p. 81; Hartmann's "Paracelsus"). "Man has two spirits, a divine and a terrestrial spirit" ("De Lunaticis," *ibid.* p. 82). "Neither the external nor the astral man is the real man ; the real man is the spiritual soul in connection with the divine spirit" ("De Fundamento Sapientiæ," *ibid.* p. 87). ". . . the organs of the body and the body itself are only form-manifestations of previously and universally existing mental states" ("De Viribus Membrorum," *ibid.* p. 219).

"Man is an instrument through which all the three worlds—the spiritual, the astral, and the elementary world—are acting. In him are beings from all these worlds, reasonable and unreasonable, intelligent and unintelligent creatures. A person without self-knowledge and self-control is made to act according to the will of these creatures" ("De Meteoris," *ibid.* p. 119).

W. W. L.

Jan. 9.

Liquid Stars.

By J. H. JEANS, Sec. R.S.

THE view that the stars are gaseous structures has held the field for more than half a century; it is implied in Helmholtz's famous 'contraction-theory' of the source of solar energy as well as in the pioneer researches of Homer Lane. Emden, surveying the subject in his "Gaskugeln," scarcely discussed any alternative possibility, although finding that the centres of the stars must be too dense for the ordinary gaseous state to be possible. This particular contradiction disappeared, and indeed the whole question assumed a new aspect, in the light of a concept I put forward in 1917, according to which the atoms in stellar interiors were in a state of extreme electronic dissociation. For, as Eddington afterwards pointed out, electrons and atomic nuclei are of such diminutive size that if these, and these alone, form the flying units of a quasi-gas, no density observed in astronomy is too high to be compatible with the gaseous state.

In the ten years which have elapsed since I first propounded this view of stellar interiors, much labour has been devoted, particularly by Eddington but also by many others, to investigating the build and properties of the stars on the hypothesis that the flying units are too small to interfere appreciably with one another's motion—on the assumption, in brief, that stellar matter behaves like a perfect gas. As the central temperatures of the stars can be calculated with some accuracy, it might seem a simple matter to estimate the extent to which these temperatures would break up the atoms, and thus to decide whether the gas-laws would be obeyed or not. It is simple if the atomic weight of the atoms is known, but not otherwise; a temperature of 100,000 degrees will break up hydrogen completely, while one of 100,000,000 degrees fails to do the same with uranium. Eddington's discussions usually assumed atomic weights of 40 or 50, and with such atomic weights the atoms would be completely pulverised; on the other hand, with atomic weights five times higher, enough atomic structure would be left to cause the gas-laws to fail, although our ignorance of the effective sizes of highly ionised atoms makes it difficult to estimate the extent of this failure.

The hypothesis that the gas-laws are obeyed has proved disappointing, its consequences obstinately refusing to fit observed facts, and the hypothesis appears to be ripe for abandonment. Eddington and myself have independently investigated the relation which would connect a star's luminosity with its mass and diameter on this hypothesis, and actual stars are all found to be substantially too faint. To put the same thing in another way, if the gas-laws were obeyed in stellar interiors, stellar diameters would be far greater than they actually are. My own latest calculations suggest that the discrepancy is probably represented by a factor of hundreds; Eddington, from different data and different assumptions, got a smaller factor, but even by giving the hypothesis all the benefits of every possible doubt, no one has succeeded in abolishing the discrepancy altogether; at the best a factor of about ten persists.

Further, I have recently shown that a star which behaved like a gas would be unstable, either dynamically or thermodynamically, or both. Some time ago Eddington and Russell found that such a star would be dynamically unstable unless its rate of generation of energy increased somewhat

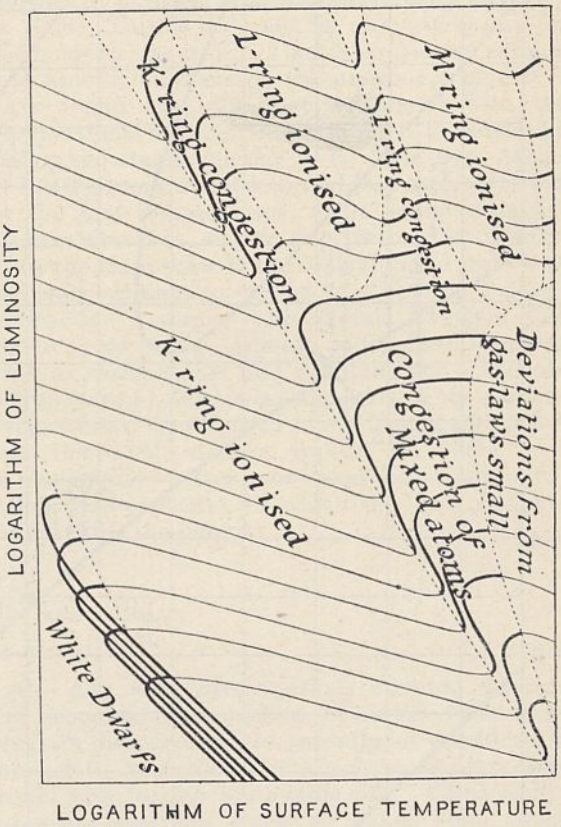


FIG. 1.—Theoretical diagram of stellar configurations predicted by the hypothesis of liquid stars.

rapidly as its temperature rose, but I have since shown that an adequate effect of this kind would render the star unstable thermodynamically; to keep our star dynamically stable, we have to endow it with precisely those properties which characterise an explosive at its flash-point. Thus a purely gaseous star must collapse dynamically, or explode thermodynamically, or both, according to the way in which its rate of generation of energy depends on its temperature; actual stars do neither.

Finally, direct evidence against the gaseous hypothesis is provided by binary stars which, to all appearances, have been formed by the break up of a single star which rotated too fast for safety. Fly-wheels and rotating masses of solid or liquid may break up in this way, but I have shown that a purely gaseous mass cannot; a mass of gas yields and expands, but can never break.

I have recently suggested (*Mon. Not. Roy. Ast. Soc.*, **87**, 400 and 720; 1927) that these various difficulties can be obviated, and a highly satisfactory agreement with observation secured, by supposing the central regions of a star to be liquid rather than gaseous, the outer layers of course remaining gaseous. In the quasi-liquid core the atoms are not completely broken up, retaining one, two, or even three rings of electrons, and as a consequence exerting about forty times the pressure they would if the gas-laws were obeyed. These deviations from the gas-laws secure the dynamical stability of the star, the nearly liquid core forming a firm unyielding base on which the outer layers of the star can rest in safety; thermodynamical stability is ensured by supposing the star's liberation of energy to be of the 'radioactive' type, so that it is approximately uninfluenced by changes of temperature and density.

Imagine a star starting from the low density with which it is born, and contracting through all its possible configurations of equilibrium. As its radius diminishes, its temperature rises as required by Lane's law, and this rise of temperature results in one ring of electrons after another being stripped from the atoms, so that the size of the atoms diminishes concurrently with that of the star. So long as the star is of low density, the gas laws are obeyed in its interior, but calculation shows that on the whole the star shrinks more rapidly than its atoms, so that in time states are reached in which the gas-laws are no longer obeyed. But while the star is shrinking steadily, its atoms shrink spasmodically as one ring of electrons after another is pulled off. If the stellar diameter is the tortoise, the atomic diameter is the hare; its progress is by spurts and rests alternately. The spurts of the hare do not save it from ultimate defeat, but they result in its being alternately in front of and behind the tortoise. Detailed calculation shows that, as the star shrinks, the deviations from the gas-laws will not increase steadily but will fluctuate, being small just after each ring of electrons has been ionised, and becoming large just before the ionisation of the next ring. At these latter stages the atoms are jammed together, a substantial degree of jamming generally being necessary to secure the ionisation of the next ring. Such, at least, are the predictions of theory for massive stars. In stars of small mass, the fluctuations are smoothed out and disappear; the hare goes with a steady gait, but is uniformly less rapid than the tortoise, at any rate until we come to the last ring of electrons, the k-ring. Here the hare makes a tremendous jump, and then has to stop since no further rings of electrons remain.

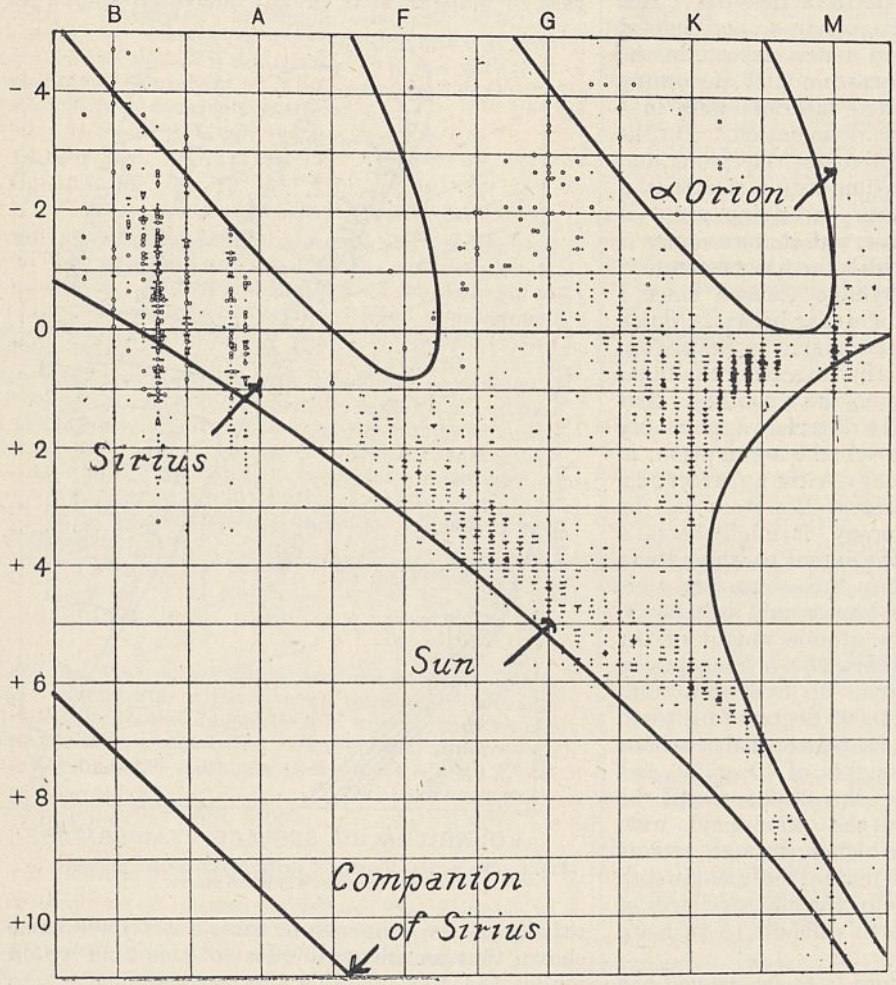


FIG. 2.—Diagram of observed stellar configurations (Mount Wilson Observatory).

Fig. 1 shows the configurations which theory predicts to be possible for stars of different masses. The abscissa is the logarithm of the stars' surface-temperature, hot and therefore small stars being to the left; the stars' diameter increases to the right. The ordinate is the logarithm of the stars' luminosity, bright stars being on top. Each continuous curve represents the theoretically possible configurations for a star of given mass, the curves for the most massive stars being on top. The fluctuations in these curves result from fluctuations in the extent of deviation from the gas-laws, and these in turn entail fluctuations of stability. Theory requires that those parts of the curve which are drawn thick shall represent stable configurations, all others being

unstable. Thus if the hypothesis of liquid stars is true, stars ought to be observed to occur only in those parts of the diagram where the curves are drawn thick.

The background of Fig. 2, taken from the Report of Mount Wilson Observatory (1921), shows the observed distribution of 2100 stars; the thick lines are curves I have drawn to divide the diagram into regions occupied by, and avoided by, stars. The general agreement with the theoretical diagram shown in Fig. 1 is so good that we need scarcely hesitate to identify corresponding areas in the two diagrams.

The belt of stars which runs diagonally across the whole diagram is called the 'main-sequence'; it contains stars of ordinary radius, such as the sun, Sirius, and Procyon. In the stars which occupy the upper reaches of the main-sequence we see that the atoms are ionised down to their K-rings, but the less luminous stars such as the sun must contain all sorts of atoms mixed. Observation shows that the left-hand edge of this sequence is very clearly defined; the stars seem to press against it like flies against a window-pane. This sharp left-hand edge is determined by the condition that the atoms are jammed together almost as tightly as they can be packed; in the configurations there represented the density is the maximum possible, short of the final ionisation of the K-ring. The "white-dwarfs," such as the companion of Sirius, with diameters only about a fiftieth of that of the sun, and densities of about a hundred thousand times that of water, consist mainly of atoms stripped bare to their nuclei, although enough K-rings must survive to build up a firm liquid base at the centre of the star. Stars of huge diameter, such as Betelgeuse (α Orionis), with diameters hundreds of times that of the sun, and mean densities only about a thousandth that of atmospheric air, must have three rings of electrons (K, L, M) left on their atoms.

The upper part of the diagram forms a macrocosm of the atom itself, the great difference between the diameters of the nucleus and the k-ring being reflected particularly clearly in the big empty gulf between the white-dwarfs and the main-sequence. Thus the structure of the atom is blazoned across the heavens, and if the physicists had failed to unravel it, the astronomers might have succeeded—in time. Theory does not fix absolute values for the co-ordinates in Fig. 1 until the atomic weights and atomic numbers of the atoms are given. I have found that the best agreement with the observational material shown in Fig. 2 is secured by taking the atomic number to be about 94. Atoms of lower atomic number would lose their electrons at too low temperatures, while those of higher atomic numbers would grip them too tightly. Thus the main mass of the central liquid regions of the stars appears to consist of a sort of "supra-radioactive" atoms, with atomic numbers just above those of the ordinary radioactive elements such as radium (88) and uranium (92). We are driven back to Newton's conception of the stars as being formed of a special 'lucid' type of matter, and this lucid matter appears to come next in complexity after our terrestrial semi-lucid radioactive elements, of which the lucid elements may well be the parents.

Power Alcohol in Australia.

By Prof. JOHN READ.

THE main sources of organic energy which are at present being utilised in Australia are black coal and brown coal. The Australian deposits of black coal form about 2·2 per cent. of the total coal reserves of the world, being thus only slightly less extensive than the deposits of Great Britain. The chief deposits of black and brown coal occupy very favourable locations in New South Wales and Victoria, respectively; and, in addition, the eastern coastal zone of Australia (including Tasmania) affords considerable opportunities for the development of hydro-electric power. In comparison with Great Britain, therefore, Australia is well endowed with natural sources of energy. At present, however, both these countries are almost wholly dependent upon outside sources for their supplies of liquid fuels, particularly for fuels fulfilling the requirements of the internal combustion engine. A very similar state of affairs exists in South Africa and in various other parts of the Empire; so that a problem of wide significance and extreme economic importance is here manifest.

In Great Britain, as in Europe generally, a good deal of attention is being paid to the Bergius process and the low temperature distillation of coal. Any such investigations directed towards the economic manufacture of liquid fuels from black or brown coal are patently of considerable interest to Australia, particularly as the processes would also furnish lubricating oils. Climatically, however, Australia differs so widely from Great Britain and northern Europe that it is not surprising to find the Australian more disposed than the European to draw upon his lavish current supplies of solar energy and less inclined to encroach unduly upon his limited capital of 'fossil sunshine.' This tendency is noticeable in a report issued recently by the Council for Scientific and Industrial Research of the Commonwealth of Australia, entitled "The Possibilities of Power Alcohol and certain other Fuels in Australia" (*Bulletin* No. 33. By G. A. Cook. Melbourne, 1927). The Australian imports of petrol and other petroleum products are increasing rapidly, the value of imported petrol alone being more than £6,500,000 per annum at the present time. Such a position is characterised as "very unsatisfactory even in times of peace, but in times of emergency it becomes positively dangerous." In 1925, the Joint Parliamentary Committee on Public Accounts took evidence on all phases of the Australian liquid

fuel problem, and came to the conclusion that "the consensus of geological opinion concerning the prospects of flow oil being discovered in commercial quantities in Australia is unfortunately not very favorable." Apart from oils obtainable from coal and shale, power alcohol and related synthetic fuels are recognised in the report under notice as the most likely substitutes for natural petroleum in Australia.

In reviewing possible Australian sources of power alcohol, it is pointed out that the starch-producing cereals are in general too important as foodstuffs to be utilised for other purposes; but in some Australian localities "the fermentation of certain varieties of tubers is by no means commercially unattractive even under present conditions and prices. Cassava, arrowroot, the sweet potato in the warmer climates, and perhaps beet in the milder, are at least worth consideration in this connexion. Some sugar-producing grasses, for example, sorghum, also have prospects." The nipa palm, which has been stated to provide a better source of sugar even than the sugar-cane, is a further raw material of considerable interest, since it grows abundantly in certain regions of Papua and the mandated territory of New Guinea.

Owing to the bulky nature of the raw materials, the conclusion is reached that at present it would be possible at the best to establish distilleries in favoured localities where the production of suitable high-grade materials presents no particular difficulty. In such districts imported petrol might be largely replaced by alcohol, but it appears that a complete replacement is incapable of achievement in the absence of a successful method for producing liquid fuels from raw celluloses. "From the point of view of the producer of power alcohol, Australia may be considered to be a favoured field of operation. . . . On the one hand, the local price of petrol is high, and on the other an ample and cheap supply of cellulosic raw materials is available. In view of the possibilities of ultimate success, and in view of the urgent national need, the chemists and bacteriologists of Australia might well co-operate and interest themselves in the problem, the former to develop the most suitable methods of producing large quantities of fermentable materials per ton of cellulose, and the latter to discover the organisms best suited for the subsequent fermentation."

As regards synthetic methods for the production of power alcohol, neither ethylene nor acetylene is held to offer promise as the basis of a satisfactory commercial process in Australia; but a comparison of the prices of petrol in the countries concerned makes it conceivable that some other synthetic process might be capable of successful operation in Australia although perhaps economically impracticable in Europe or the United States.

Technologically, the best raw material available in Australia for manufacturing power alcohol is molasses. In the record season of 1925–26, the total production of crude sugar in Australia exceeded 500,000 tons; of the accompanying 120,000 tons of molasses, however, a large proportion was either used as fuel, cattle food, etc., or wasted. If utilised wholly in the manufacture of power alcohol, this by-product would yield only about one-twentieth (7,800,000 gallons) of the current Australian demand for motor fuels.

The Australian investigations on power alcohol include experiments on the cultivation of sorghum, artichokes, sugar beet, cassava, sweet potatoes, arrowroot, etc.; the preparation of alcohol from the carbohydrates of zamia palms, grass-tree cores, and prickly pear; the hydrolysis and fermentation of common Australian hardwoods (NATURE, Oct. 8, 1927, p. 522); and the use of alcohol as an engine fuel under various conditions. Coming to actual commercial achievement, a power alcohol distillery with a capacity of about one million gallons per annum started production in February 1927, at the Plane Creek sugar mill, near Mackay, Queensland. The raw materials are molasses and certain starchy crops, including cassava and arrowroot. The fuel, consisting essentially of a mixture of alcohol and ether, is marketed under the name of 'powrac.' As an extension of this enterprise it is proposed to erect other distilleries in the Cairns district of Queensland.

Obituary.

PROF. C. DIENER.

CARL DIENER, who died in Vienna on Jan. 6, was born in that city on Dec. 11, 1862, there received the whole of his formal education, and there ran his professional career. As a student there was no need for him to go elsewhere, since he had as teachers some of the most eminent men of the age: in geography, F. Simonyi; in geology, E. Suess; and in palæontology, M. Neumayr. But when he had finished his student course in 1883, he at once turned for a wider experience to mountaineering in the Alps, in Dauphiné, and in the Pyrenees. He was among the first to introduce Alpine climbing into Austria itself, and was for seven years president of the Austrian Alpine Club; his membership of the English Alpine Club was, to his deep regret, broken by the War.

Naturally Diener did not leave his scientific interests behind when he sought the high mountains, and on the results he obtained in the Lebanon, Antilebanon, and the region of Palmyra, he habilitated as privat-docent for geography so early as 1886. Geology, however, claimed more and more of his attention, and the turning point of his career came when in 1892 he joined an expedition financed by the Government of India and the Vienna Academy, to examine the Trias of the Central Himalayas. In the first place, the valuable geological results obtained led him to extend his teaching to geology in 1893, and caused him in 1897 to be nominated professor extraordinarius of that science. Secondly, he was associated on the expedition with Griesbach and Middlemiss of the Indian Geological Survey, and this led to an

intimate connexion that ceased only with the War. Thirdly, the rich collections of fossils made by the expedition inevitably involved him more and more in palæontology. Thus in 1903 he became professor extraordinarius, and in 1906 was appointed full professor of palæontology and holder of that chair in the University of Vienna. His academic progress was fitly rounded off by his election as Dean of the philosophical faculty for 1919–20, and as Rector of the University for 1922–23.

Thus, for all his geographical interests and tectonic surveys, it is mainly as a palæontologist that we know and honour Diener. Englishmen are most familiar with the twelve magnificent monographs on Himalayan fossils which he contributed to *Palæontologica Indica* from 1895 to 1915. His most distinctive work in this line was on the Triassic Cephalopoda, where, on the death of Mojsisovics in 1907, he succeeded to the prime authority. The material for his Triassic studies came not only from the neighbouring Alps and the Himalayas, but also from Madagascar, Timor, Tonkin, Siberia, and Japan. His masterly summary, "Die marinen Reiche des Trias Periode" (1915), embodied the results of this work and of his extensive travels to many of the famous Trias exposures of the world. Would that he had given us an equally good summary of his knowledge of the Triassic cephalopods! From this, in his Catalogue (1915), he intentionally refrained, holding that the state of ammonite classification did not permit of it.

As palæontologist Diener was no mere describer, but interested himself in such subjects as the mode of life and distribution of the ammonites, the phenomena of convergence, and more generally in all those relations of fossil faunas to the rocks in which they occur that make up the division of palæontology now known as biostratigraphy. Indeed his "Grundzüge der Biostratigraphie," published in 1925, forms a conspectus of the subject no less admirable for clarity and sanity of treatment than for the wide learning on which it is based. The preparation of this work occupied him during the later years of public distress and of personal suffering from the internal disease to which he has at last succumbed.

Diener had a quiet but attractive personality, and his clear elocution and interesting subject matter made his lectures peculiarly inspiring. He was a member of the Vienna Academy and the recipient of many honours from other learned bodies. In 1913 he was made a corresponding member of the British Association. The Geological Society of London elected him foreign correspondent in 1912 and foreign member in 1926, an honour which he valued highly as a recognition of his long-continued work for the geology of the British Empire. F. A. B.

MR. E. R. WAITE.

THE death is announced of Edgar Ravenswood Waite at Hobart, Tasmania, during the nineteenth meeting of the Australasian Association for the Advancement of Science. Mr. Waite was born at Leeds in 1866, and at an early age took a keen interest in natural science; he was eventually appointed curator of the Leeds Philosophical Society, and was joint author with the late W. D. Roebuck of a work on "The Vertebrate Fauna of Yorkshire." He took an active part in the organisation of the Yorkshire Naturalists' Union, and at one time was joint-editor of its well-known organ the *Naturalist*. In 1892 Mr. Waite was appointed zoologist to the Australian Museum, and shortly afterwards accepted the appointment of Curator to the Canterbury Museum, New Zealand. Afterwards he accepted the directorship of the Government Museum at Adelaide, South Australia. Two years ago he returned to Europe, and after seeing the various museums on the continent and America, he visited his native place at Leeds, and was entertained there by many of his former colleagues.

Mr. Waite specialised in the study of mammalia and fishes, and took several expeditions to the Antarctic, where to-day a mountain bears his name. He described the fishes taken on the Shackleton and Mawson Expeditions, and is the author of the standard work dealing with the snakes of Australia. During the War he did good work by visiting various territories in the Pacific. He also collected extensively in the New Ireland and New Britain areas, and his Museum is considerably richer as a result of his work.

Mr. Waite's early experience as editor of the *Naturalist* and in other ways resulted in his being a prolific writer, and more than a hundred monographs and papers are to his credit. T. S.

WE regret to announce the following deaths:

Prof. José Rodriguez Carracido, for many years Rector of the University of Madrid, who worked chiefly on the action of alkaloids upon organisms and was the author of several text-books on biochemistry, aged seventy-two years.

Mr. J. H. Durrant, who was associated for many years with the late Lord Walsingham's collection of Microlepidoptera at Merton Hall, Norfolk, and afterwards at the British Museum (Natural History), on Jan. 20, aged sixty-five years.

Dr. Harry N. Gardiner, emeritus professor of philosophy at Smith College and president in 1907 of the American Philosophical Association, on Dec. 29, aged seventy-two years.

Prof. R. W. Genese, professor of mathematics in the University College of Wales, Aberystwyth, from 1879 until 1919, on Jan. 21, aged seventy-nine years.

Major-General G. W. Goethals, chief engineer for the construction of the Panama Canal and first civil governor of the Canal Zone, on Jan. 21, aged sixty-nine years.

Mr. M. Longridge, C.B.E., president in 1917 of the Institution of Mechanical Engineers, on Jan. 18, aged eighty years.

Count Meredyth de Miremont, author of well-known star charts and of "Practical Methods in Modern Navigation," on Jan. 21.

Dr. George Muirhead, author of "Birds of Berwickshire" and other works on Scottish natural history, on Jan. 29, aged eighty-two years.

Mr. P. D. Warren, C.M.G., formerly Surveyor-General of Ceylon, on Jan. 28, aged seventy-six years.

News and Views.

IT was announced last week that Lord Bledisloe is resigning his post as Parliamentary Secretary to the Ministry of Agriculture to take up the appointment of chairman of the Imperial Grassland Association, which is being formed under the auspices of Imperial Chemical Industries, Ltd., with the object of improving the pasture land of Great Britain and of the Overseas Empire. Lord Bledisloe has rightly earned a great reputation as one who has taken the keenest interest in all phases of agriculture and has devoted so much of his energies to the furtherance of its well-being. Whilst his loss to the Government will be keenly felt, his new position will offer plenty of scope for his great enthusiasm and his wide experience of agricultural matters. The formation of the Imperial Grassland Association, further details of which will be awaited with great interest, is a further step in the developments which have been fostered in recent years by Imperial Chemical Industries, Ltd., through their associated companies, Synthetic Ammonia and Nitrates, Ltd., and Nitram, Ltd. The former company, at its great works at Billingham-on-Tees, now possesses plant with a total output capacity of fixed nitrogen equivalent to about 1000 tons of ammonium sulphate per day, and further big extensions are planned involving the production of a wide range of fertilisers. Nitram, Ltd., besides being responsible for the sale of the ammonium sulphate and other fertilisers produced at Billingham, as well as for most of the by-product ammonium sulphate produced in Great Britain, has recently established an agricultural research and advisory department, under the directorship of Sir Frederick Keeble, and with a strong scientific staff and well-equipped laboratories and experimental farm.

ONE of the chief directions in which the activities of Nitram, Ltd., have been exercised is in the development of the intensive system of grassland management. This system aims at greatly increasing the productivity of grassland by the application of a complete manure, including nitrogen. Trials have been carried out all over England during the past two years, with most encouraging results. The stock-carrying capacity of pasture land has been doubled or trebled, with a proportionate increase in the milk production per acre. Thus, in one trial the milk produced during the grazing period, from treated pasture, was raised to 713 gallons per acre, which is equivalent in food value to the production of arable land giving a yield of 4½ quarters of wheat per acre. Hitherto the stock farmer has been dependent for a large proportion of the protein in his feeding stuffs on imported concentrates (oilcakes). The price of nitrogen in this form, always high, is now much higher than before the War. Nitrogen in the form of artificial fertilisers, on the other hand, is now actually cheaper than before the War. The new system of grassland management, therefore, holds out to the farmer the possibility of using this cheap nitrogen for the production on his own land of a large proportion of the protein food needed for his stock, and that in the ideal form, as young grass. Moreover, the money paid for that nitrogen remains in the country, instead of going abroad in payment of imported concentrates. Much has still to be done in working out the details and the economics of this system, both in Great Britain, already famous for the quality of its grassland, and in the Overseas Empire, in many parts of which, as for example in New Zealand, grassland husbandry is a major industry, but the prospects are encouraging. The modern developments of the synthetic fertiliser industry make it abundantly clear that the manufacturer and the farmer are united by a common bond of interest in promoting the prosperity of the agriculture of the British Empire both at home and overseas. This bond is notably strengthened by the association of an agriculturist of the eminence of Lord Bledisloe with the great industrial interests represented by Imperial Chemical Industries, Ltd.

SIR JAMES WALKER, whose impending retirement from the chair of chemistry in the University of Edinburgh is announced elsewhere in this issue, received his early training in chemistry in Edinburgh under Crum-Brown and at Leipzig under Ostwald. He also carried out research work at Dundee with Carnelley, and then went to University College, London, as an assistant to Sir William Ramsay. In 1894 he was appointed professor of chemistry at University College, Dundee, and in 1908 was appointed to succeed Prof. Crum-Brown at Edinburgh. Sir James has been an indefatigable worker. While his name will always be associated with the development of physical chemistry, his work has covered a great range of subjects—the theory of solution, hydrolysis, the theory of amphoteric electrolytes and the electrolytic synthesis of organic acids, to mention only a few of the problems at which he has worked. As an author of chemical text-books he is equally well known. His "Introduction to Physical Chemistry," originally published in 1899, now in its tenth edition, is still widely used in both Great Britain and the United States; amongst his other text-books may be mentioned his "Organic Chemistry for Students of Medicine," and a most useful introductory work on "Inorganic Chemistry."

DURING the War Sir James Walker rendered valuable services by erecting and equipping, in conjunction with some of his colleagues in the Chemistry Department of the University of Edinburgh, a factory—acknowledged to be a model of its kind—for the manufacture of T.N.T., which produced this explosive at an exceedingly economical rate. After the War the increase in the number of students and the development of the science made it necessary for the University to undertake the erection of the new chemical laboratories. Sir James had the principal share in the conception and execution of this project, which has resulted in the possession by the University of a Department of Chemistry at King's Buildings which is unrivalled in Britain. The foundation stone

of the Department was laid by His Majesty the King in 1920, and it was opened on completion in 1924 by the Prince of Wales. In addition to his teaching and research work, Sir James has been an active member of the various learned societies connected with his subject. He is a fellow of the Royal Society and is at present serving on its Council. He was president of the Chemical Society (1921–23), and in 1913, at the invitation of the Council, delivered the Van 't Hoff Memorial Lecture. He received the degree of LL.D. from the University of St. Andrews in 1895 and was knighted in 1921.

A THOROUGH trial of geophysical prospecting methods will be carried out in Australia during 1928 and 1929 under an agreement concluded between the Commonwealth Government and the Empire Marketing Board. The Australian arrangements will be in the hands of the Council for Scientific and Industrial Research and the Development and Migration Commission. Mr. Broughton Edge will be in charge of the survey party and, with two of the assistants who have been with him in Rhodesia, will commence his work next March. The rest of the staff will probably be Australian, and will include a gravimetrist, an electrician, two surveyors, and a laboratory assistant. A suggestion that the Department of Scientific and Industrial Research should appoint a physicist to accompany the party has been cordially welcomed in Australia. In order that the best available information may be placed at the disposal of Mr. Edge, a conference is being arranged of the heads of State Departments of Mines, Geological Surveys, and Physics Departments of the universities to discuss the general position, and particularly the question of the most suitable localities for the tests. Later, a smaller body will be constituted to ensure intimate touch with State Government organisations during the progress of the work.

AT a meeting of the Surveyors' Institution on Monday, Jan. 9, Mr. C. H. Bailey read a paper on "The Reports of the Royal Commission on Mining Subsidence." In the printed version available he gives a summary of the position and main recommendations contained in the Final Report of the Commission by way of an appendix, whilst his paper was devoted to a discussion of these points. Upon the whole, Mr. Bailey has dealt very fairly with the Report of the Commission, except for the fact that he does not seem to have borne in mind the exact terms of reference. Thus he states that "the questions which are discussed by the Commissioners are these: (1) Can damage due to subsidence be prevented or lessened? (2) Does the existing law bear unfairly on any section of the community?" In actual fact it is only the latter of these two questions which was, strictly speaking, before the Commission, the terms of reference being "To consider the operation of the law relating to the support of the surface of the land . . . and to report what steps should be taken, by legislation or otherwise, to remedy equitably to all persons concerned any defects or hardships that may be found to arise in existing conditions."

THE first of Mr. Bailey's questions was only discussed incidentally by the Commission, and therefore no recommendations are made with respect to it. The main recommendation of the Commission referred to small house property, and Mr. Bailey states it in the following terms: "The proposal to restore the right to support or compensation to houses of £40 or less rateable value." This statement involves a somewhat serious error; the Commissioners definitely do not attempt to restore the right to support (where this for any reason has been lost); they limit their recommendation to compensation, and the reason for this limitation is very clearly and fully stated in the Report of the Commission itself, in which it is pointed out that the legal position has been profoundly modified by the Mines (Working Facilities and Support) Act, 1923, which enacts that when property entitled to support is injured, the owner is entitled to pecuniary compensation, but must be content with such compensation, and in view of the very definite terms of the Act the Commission could not attempt to restore any right of support, but could and would only recommend means for awarding pecuniary compensation. The point is rather an important one, but apart from this it may be said that Mr. Bailey's review of the Commission's Report is a very reasonable one.

ORDINARY telegraph lines are often seriously affected by auroræ, storms, and floods. A novel way of overcoming these difficulties has been successfully tried in Canada. The offices of the Canadian National Railways at Montreal and Winnipeg, a distance of 1300 miles, are now in direct telephonic communication with one another. Before the line was installed, calls from Winnipeg had to go by Chicago and St. Paul. The telephone messages are transmitted over the same wires that convey telegraph messages in the Morse code, the carrier current system familiar to radio engineers being employed. The telegraph and telephone messages can be sent simultaneously, there being no interference. At the receiving end of the line the messages are sorted out by special apparatus, each tuned to a particular frequency. The telephone messages are practically unaffected by electrical storms which throw the older telegraph services out of commission. Experience has shown that earth currents have no effect whatever on the service. Poles and wires may be submerged without affecting the transmission. Even when one of the wires was cut, it was still possible to work the line successfully.

THE nomenclature of disease has at present no principles. Since it was delimited from other vague fevers by the discovery of its causative agent, the fever which prevails round the Mediterranean, and is caused by the *Micrococcus melitensis*, has generally been known as 'Malta fever.' The inhabitants of Malta think that this association is prejudicial to their moral and material interests, and want the term 'undulant fever' substituted. Surely they should rather be proud that their island was the scene of one of the best pieces of modern work in bacteriology and hygiene. They would do better to devote their energy to commemorating the name of Sir David

Bruce by placing the causative organism in the genus Brucella instead of Micrococcus, and in dealing so effectively with their goats (which are the reservoir from which human infections are derived) that the island stands out as the one place where the fever cannot possibly be caught. At present 'Malta fever' is obviously the appropriate name for a disease due to a *melitensis* microbe: to change it would do no good and only create confusion. About the right name of the organism there is fortunately no doubt: *melitensis* is its first and only title.

IN the Friday evening discourse delivered at the Royal Institution on Jan. 27 on "Prehistoric Cave Art," Miss D. A. E. Garrod stated that although remains of Upper Palæolithic man are found all over Europe, the artistic impulse which gave rise to the animal paintings of the caves appears to be a local development, practically confined to central and southern France and northern Spain, the three chief centres being the Dordogne, the Pyrenees, and the Cantabric region. Cave art takes the form of painting, engraving, and sculpture. Owing to the fact that the paintings and engravings are often superimposed, it has been possible to work out their relative ages, and to establish a series showing a more or less continuous development from simple outlines, through monochrome shading, to the great polychromes which reach their zenith in the cave of Altamira. Remarkable sculptures in high relief are found in the rock-shelter of Cap Blanc near Les Eyzies, buried in deposits of early Magdalenian age, while in two Pyrenean caves which have been rendered nearly inaccessible by running water, clay models of animals have been preserved. It is clear from internal evidence that the art of the caves was inspired by a double purpose. In some cases it was directed to the promotion of fertility in the animals on whom man depended for his food; in others to ensuring good luck in the chase.

PROF. S. LANGDON'S report on the work of the Oxford-Field expedition's excavations during the current season at Kish, in his letter to the *Times* of Jan. 28, is of greater interest in its general bearing than for the actual finds recorded. The expedition is now bringing to light from the lowest levels of this city, which tradition says was the first capital of Sumer after the Flood, similar painted pottery and pictographic tablets to those found at Jemdet Nasr, 17 miles to the north-west. The civilisation of the two sites is not that of Sumer; both the pictographic script and the system of numeration are different. The painted pottery also differs from the painted ware of the southern area, that is, Sumer proper; but it is related to that of early Elam. Some of the pictographs are strikingly like those of the seals from Harappa and Mohenjo-Daro in India. This script is one of a group of five independent scripts belonging to the same prehistoric civilisation which spread over Asia from China to the Mediterranean before 4000 B.C., the other members of the group being Sumerian, proto-Elamite, Indus Valley, and early Chinese. The existence of a new branch of this homogeneous culture characterised by monochrome and polychrome ware in the region of Central Mesopotamia, between Babylon and the Tigris, is, Prof. Langdon points out, a new factor in ancient history. The discovery by the expedition of good Sumerian tablets at levels dated at 3500 B.C. proves that this culture ceased to exist at Kish before that date. Numerous seals and shell plaques also testify to the Sumerian occupation after its disappearance.

MUCH ingenuity has recently been expended in devising a code which would enable any listener anywhere to identify at once the broadcasting station to which he may be listening. Amongst the suggestions are various ways of sending morse signals by bells, hooters, and trumpets. In an article in the *Wireless World* for Jan. 11, Captain Eckersley points out that the vast majority of listeners to broadcasting have no interest in trying to identify the distant broadcasting station, the attenuated waves from which produce a curious noise in a multivalve receiving set. It would be foolish to handicap every item of a performance by a discordant signal merely to enable a few researchers to identify a particular noise. If it is essential that they satisfy their curiosity, then they should use a wavemeter, and look up a list of stations. It is difficult to see what useful purpose is served by identifying a very weak signal received on a large multi-valve set. The ether is full of strange noises, but those due to natural phenomena are of the greatest importance to physicists, and we are only slowly learning how to identify them. Excellent work is being done at the present time in attempting to link up European broadcasting stations to Great Britain by land telephone cables. In this way the local station can radiate the performances taking place abroad, the announcer telling what we are to hear and where it comes from. We look forward to hearing in this way in London an opera in Vienna or a German orchestra in Berlin. Direct listening to foreign and distant stations, whether identified or not, is rarely pleasurable. It is probable that, in the future, by utilising short wave transmissions, broadcasting programmes from any part of the world will be radiated with but little distortion from many local stations.

IN the construction of the Scottish section of the British national 'grid' of electric overhead wires, steel cored aluminium conductors are being used. Some engineers have expressed doubts as to the permanence of the qualities of these composite conductors. It is satisfactory, therefore, to read a paper by E. T. Painton in the *Electrician* for Jan. 27 giving both experimental and practical results on these wires extending over a period of years. It is known that pure aluminium does not corrode even in the neighbourhood of cement works. On the other hand, aluminium is strongly electro-positive, and unless a junction can be kept perfectly dry, it should not be used in contact with other metals. We might expect that the natural tendency of steel to rust would be increased in the case of composite wires by electrolytic action. Practical experience, however, has proved that over long periods of operation no case of corrosion has occurred. In order to test whether a single layer of aluminium wires was sufficient to protect the

galvanised steel core, Mr. Painton erected steel cored aluminium wires along the sea wall of a harbour in Northern Ireland. On stormy days the wires are wet with sea water and subjected to the penetrating action of the wind. Every six months short lengths of the wires were cut off and their mechanical and electrical properties were measured and their appearance noted. After five years, there has been no diminution in the strength of the aluminium strands, and although the galvanising of the core is no longer bright, there is no sign of rust. The galvanising still withstood three full minute immersions in copper sulphate. These results are important, as steel cored aluminium is 80 per cent. stronger mechanically than the equivalent copper cable. The huge State network in France, which forms an important section for the rehabilitation of the devastated areas, consists almost entirely of steel cored aluminium wires.

THE use of electricity for baking ovens was discussed by E. Styles in a paper read to the Institution of Electrical Engineers on Jan. 19. In Great Britain very little progress has been made in the application of electric heating to bakers' ovens. This is generally attributed to the high cost of electrical energy. But the author showed that the cost of the energy is only about three per cent. of the price of the bread when energy can be obtained at $\frac{3}{4}d.$ per unit. The oven can be heated very quickly by electric current, and it can retain its heat for many hours after the current has been switched off. As baking is generally carried out during the night, most electric supply companies would allow special rates for these ovens. When an electric oven is used, there is a considerable saving of floor space and of labour, as dirt and ashes are eliminated and no cleaning of flues is necessary. Owing to the ease with which the temperature can be maintained constant, there is an appreciable saving in the quantity of ingredients used. On the Continent and in the United States, the number of bakeries which heat electrically is rapidly increasing. In several towns in Great Britain they could be installed economically at the present time.

A RECENT addition to the Department of Zoology of the British Museum (Natural History) is a mounted specimen of a young Sumatran rhinoceros, presented by His Highness the Sultan of Perak; the specimen is of exceptional interest as exhibiting the very hairy nature of the skin in the young of this species. The Department has also acquired the skin and skeleton of a gorilla collected for the Museum in the Belgian Congo, by special permission of the Belgian Minister for the Colonies. Through the generosity of Sir George H. Kenrick, the series of types contained in the Museum has received a valuable addition in the shape of 218 specimens, of which 197 are types, of New Guinea and Madagascar butterflies and moths. This donation comprises the types of 21 species of butterflies and 176 species of moths, many of which were described by Sir George Kenrick himself, and also the Malagasy Geometridæ described by Mr. L. B. Prout.

AMONG recent purchases for the Geological Department the most interesting is a curious fossil from the lithographic stone of Solnhofen in Bavaria. It looks like two pieces of a large curved feather, and is thought to be a colony of hydroid polyps related to the modern Sea Fir. This fragment was no doubt torn up by a storm from a neighbouring sea-floor and swept on to the flats of the Solnhofen lagoon at the time when Kimmeridge Clay of Britain was being laid down. A small lot of fossils recently obtained from the London Clay included the shell of a Pinna in which were several pearls. Recent donations include the pupa-case of a dragon-fly found by Mr. W. H. Wickes in the Rhætic plant bed near Bristol; 147 shells from the Cretaceous and Pliocene rocks of Angola, collected by Mr. Beeby Thompson; five bony fishes from the Eocene of Egypt, including a new sole and a new form of primitive eel, discovered by Mr. C. Crawley. The total number of visitors to the Museum during 1927 was 569,318, and constitutes a record. The highest attendance in any previous year was 535,116 in 1909. The number of visitors on August Bank Holiday, 13,431, while not quite the largest recorded on any one day, is in striking contrast with the number, 506, on Boxing Day. These figures illustrate the effect on museum attendances of two different types of bad bank-holiday weather.

DR. C. G. ABBOT, who is well known for his work on the measurement of the solar constant, has been elected secretary of the Smithsonian Institution of Washington.

THE annual meeting of the Iron and Steel Institute will be held on May 3–4, at the house of the Institution of Civil Engineers, Great George Street, London, S.W.1, under the presidency of Mr. Benjamin Talbot. The autumn meeting of the Institute will be at Bilbao during the week commencing Sept. 24.

THE Geological Society of Stockholm has elected the following to corresponding membership: Dr. F. A. Bather, London; Prof. Reginald Daly, Cambridge, Mass.; Prof. P. Niggli, Zurich; Prof. Charles Schuchert, New Haven, Conn.; Dr. E. O. Ulrich, Washington.

THE Ministry of Health has issued "Amendment Regulations" dealing with the labelling of condensed and of dried milks. They are primarily designed to secure that in the labelling of condensed and dried skimmed milks, greater prominence shall be given to the words "Unfit for Babies." These Regulations are to come into force in May and in September 1928, respectively.

OWING to the occurrence of a number of cases of smallpox among casuals during recent weeks, the Minister of Health has directed that from now until Mar. 31 next, the medical officers of all Unions shall examine all casuals admitted, with the view of detecting cases of smallpox (Circular 859).

SEVERAL letters on sun images through window glass, referring to Prof. S. Russ's letter in our issue of Jan. 14, have been received, which record similar observations. It seems probable that the formation of these images is due to parts of the glass having an appreciable convexity, which cannot, however, be detected by the naked eye.

AT the anniversary meeting of the Royal Anthropological Institute, held on Jan. 24, Prof. J. L. Myres was elected president in succession to Mr. H. J. E. Peake, whose term of office has expired. The vacancy for a vice-president was filled by the election of Prof. H. J. E. Fleure, and Mr. G. D. Hornblower was elected to the office of honorary treasurer in succession to Dr. F. C. Shrubsall, who has resigned on account of pressure of other work.

THE twentieth annual general meeting of the Institute of Metals will be held in London on Mar. 7 and 8, under the presidency of Dr. W. Rosenhain, Superintendent of the Department of Metallurgy and Metallurgical Chemistry in the National Physical Laboratory. The papers to be read and discussed include contributions from metallurgists in Germany, Japan, and the United States, as well as Great Britain. The autumn meeting will be held at Liverpool on Sept. 4 to 7.

IT is announced in *Science* that the Edison medal, conferred annually by a committee of the American Institute of Electrical Engineers for "meritorious achievement in electrical science, electrical engineering, or the electrical arts," has been awarded for the year 1927 to Dr. William D. Coolidge, assistant director of the research laboratory of the General Electric Company, "for his contributions to the incandescent electric lighting and to the X-ray arts."

THE ninetieth meeting of the German Society of Naturalists and Physicians will be held at Hamburg on Sept. 16–28 next. Special emphasis will be given in the general meetings and in the sections to the relationship of German science and medicine to maritime studies and to overseas countries. Particulars of the meeting can be obtained from Prof. B. Rassow, Geschäftsstelle der Gesellschaft Deutscher Naturforscher und Ärzte, Leipzig C.1, Gustav-Adolf-Str. 12.

THE Registrar-General has issued the provisional figures for England and Wales of the birth-rate, death-rate, and infantile mortality during the year 1927. The birth-rate and the death-rate per 1000 of population are respectively 16·7 and 12·3. The birth-rate is 1·1 per 1000 below that of 1926, and is the lowest rate recorded since the establishment of civil registration. The death-rate is 0·7 per 1000 above that of 1926, the excess being due to the high mortality in the first and fourth quarters of the year. The infantile mortality rate (deaths under one year per 1000 births) is equal to that of 1923, the lowest on record.

As is generally known, an interest in the business of Messrs. Adam Hilger, Ltd., was acquired by Messrs. Vickers, Ltd., in 1916. On the conclusion of the War, this connexion in great part lost its utility for both parties, and an arrangement has now been made whereby the whole of the shares will be held by Mr. F. Twyman, F.R.S., and the widow and children of the late Mr. Otto Hilger. One of the latter, Mr. John Adam Hilger, now becomes a director of the firm.

LLOYD E. JACKSON and George H. Johnson, senior industrial fellows of the Mellon Institute of Industrial Research, University of Pittsburgh, have been elected to honorary membership in the U.S. National Association of Dyers and Cleaners. Mr. Jackson, who is in charge of the research of the Mundatechnical Society of America, has made a number of notable contributions to garment-cleaning practice and is the joint inventor of a successful process of moth-proofing wearing apparel and house furnishings. Mr. Johnson has enjoyed much success in the investigational work he is carrying on for the Laundryowners' National Association; he is also the author of standard treatises on textiles and laundering.

PROF. E. N. da C. Andrade's recent course of Christmas Lectures at the Royal Institution on "Engines" is to be published in book form this spring by Messrs. G. Bell and Sons, Ltd.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just issued another of their well-known Catalogues (No. 413). It gives the titles, and in many cases other particulars, of nearly 700 works relating to astronomy, chemistry, physics, engineering, electricity, mathematics, and navigation. The Catalogue should be seen by readers interested in these subjects.

THE returns furnished for 1926 have afforded the first opportunity for a comprehensive survey of the work done by local authorities in Great Britain under the national scheme for the treatment of tuberculosis since its initiation. The Ministry of Health has therefore considered it desirable to issue a memorandum containing an analysis of these returns (Memo. 131/T.). The items are arranged under forty-six headings, and are reduced to a percentage standard for all the authorities, county councils and joint committees, county borough councils, and metropolitan borough councils. By this arrangement the different local authorities and their officers will be able to compare their own figures and results with those of others. Thus, columns 4 to 6 of the Table give some idea of the efficiency of the notification of tuberculosis in each area, which varies from 100 per cent. in some areas to so low as 70 per cent. in others. Column 7 gives the percentage of tuberculosis cases on the Dispensary Register per 100 of notifications, and the figures vary from 98 in some areas to so low as 10 in one. For England as a whole, the death-rate from all forms of tuberculosis in 1926 was 957 per million population, but in different areas it varies from a maximum of 1776 (South Shields) to a minimum of 530 (Peterborough). Of the metropolitan boroughs, Shoreditch and Bermondsey have the highest tuberculosis death-rate, and Hampstead the lowest. We notice an error in the return for Wandsworth, given as 165: it should be 865. This statistical analysis should be very valuable, and ought to be a stimulus to some of the authorities to improve their tuberculosis administration.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in mathematics at the Bradford Technical College—The Principal, Technical College, Bradford (Feb. 11). A male senior secretary in the Academic Registrar's department, the University of London—The Principal Officer, University of London, South Kensington, S.W.7 (Applications for form by

Feb. 6, return of form by Feb. 11). A professor of public health at the London School of Hygiene and Tropical Medicine—The Academic Registrar, University of London, South Kensington, S.W.7 (Feb. 16). A professor of pathology at the London (Royal Free Hospital) School of Medicine for Women—The Academic Registrar, University of London, South Kensington, S.W.7 (Mar. 1). An assistant in the botany department of the University of Aberdeen—The Secretary, University, Aberdeen (Mar. 1). A science master under the Agricultural Department, Nigeria—The Secretary, Board of Education, Whitehall, S.W.1 (marked C.A.(N.)), or The Secretary, Scottish Education Department, Whitehall, S.W.1 (marked N.) (Mar. 31). A whole-time research worker, for research work on infectious diseases of the bowels, with special reference to industrial areas, at the Calcutta School of Tropical Medicine—The Director, School of Tropical Medicine and Hygiene, Calcutta (April 15). An assistant pathologist at the Royal Infirmary, Leicester — The House Governor and Secretary, Royal Infirmary, Leicester. Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A temporary post in the department of mycology of the Rothamsted Experimental Station, for research work on wart disease of potatoes—The Secretary, Rothamsted Experimental Station, Harpenden, Herts. A senior unqualified assistant in the biochemical department of the Wellcome Physiological Research Laboratories, Beckenham—The Director.

ERRATUM.—Through misunderstanding of a telegraphed correction to the first footnote to the table in Mr. E. J. Williams' letter in NATURE of Jan. 28, p. 135, the expression for $(\rho-1)/(\rho+1)$ was wrongly printed $(15/8)\sigma a \div (15/8)\sigma a/8$ instead of $(15/8)\sigma a$.

Our Astronomical Column.

PHOTOGRAPHY OF THE CORONA WITHOUT AN ECLIPSE.—G. Blunck describes in *Astr. Nachr.*, 5539, some interesting experiments on obtaining photographic images of the corona in full sunlight. He points out as the probable cause of the failure of previous attempts of this kind that they were made in too short a wave-length. He gives the percentage difference of illumination between the corona and the sky background as 0·2 per cent. at λ5000, 0·8 at λ7000, 1·7 at λ8500, 2·5 at λ9500; he states that Pinazyanol gives a maximum degree of sensitivity at λ6500, Dizyanin at λ7500, Neozyanin at λ8000. The last named makes corona photography just possible, but the author claims to have obtained a new sensitising dye called Prozyanol, which gives a maximum sensitivity at λ8500.

Full directions are given in the paper as regards the exposure, development, and subsequent treatment of the plates; there is a warning that the author himself suffered from the poisonous nature of some of the chemicals employed. Reproductions are given of three images obtained on Sept. 6 last, which strongly suggest that they are real photographs of the inner corona. An obvious test would be to take photographs by this method when the moon's disc is just outside that of the sun. If the coronal image is real, the dark outline of the moon should be traceable upon it.

M. ANTONIADI'S OBSERVATIONS OF MERCURY AND THE JOVIAN SATELLITES.—Allusion has already been made in this column to M. Antoniadi's examination of Mercury during the last three years with the great Meudon refractor, which confirmed the 88-day rotation. He gives further details of his observations in *L'Astronomie* for January, and notes that on several days observations were continued for several hours, during which no shift of the markings was discernible. He considers that there is evidence of some atmosphere on Mercury, producing thin veils of mist at times over the markings, since their darkness appeared to vary from time to time, though the conditions of our own atmosphere were appreciably the same. He gives a diagram illustrating the libration of the illuminated region arising from the eccentricity of the orbit. This was constructed by utilising the proposition that the angular motion of a planet about the empty focus is very nearly uniform.

During the same period, M. Antoniadi examined the satellites of Jupiter, of which he gave interesting drawings in *L'Astronomie* for last August. He notes the extremely high albedo of satellite II., which he states to be the highest of any body in the solar system. There had previously been no certain detection of any markings on this satellite, but a dusky marking was discerned on Sept. 14, 1926. The presence of a bright equatorial belt on satellite I., first announced by Barnard in 1893, was confirmed. Occasionally in transit across Jupiter this bright zone was alone visible, the rest of the disc being indistinguishable from the planetary background.

PARALLAXES OF BINARY STARS DEDUCED FROM ASSUMPTIONS OF THEIR MASS.—It has for a long time been the custom of the computers of the orbits of binary stars to append to their resulting elements the 'hypothetical parallax,' which is that resulting from an assumed mass of the system, generally taken either equal to that of the sun or double this. A further refinement was possible when Prof. Eddington showed that mass and absolute magnitude were correlated. Assuming the mass-luminosity relation we can make a closer approximation to the dynamical parallax than that based on the assignment of a uniform mass to all stars.

Mr. R. O. Redman applies this method to 803 stars in *Mon. Not. Roy. Ast. Soc.* for November. 120 of the stars have determined orbits; the method can be applied with greater confidence to these. The remaining stars have arcs observed which are too short for the deduction of individual orbits, but they can be used statistically, as suggested by Russell and Hertzsprung. The results for the dwarf stars are fairly consistent, and give absolute magnitudes agreeing with the Russell diagram. The mean absolute magnitudes for different spectral types are: *F*0, 2·7; *F*5, 3·4; *F*8, 3·8; *G*0, 4·1; *G*5, 4·9; *K*0, 4·7. The mean result for the solar velocity comes out 21·67 km./sec., and the mean kinetic energies for stars of the different types come out fairly uniformly, though the results for types *B*0 to *B*6, and for the giants from *F* to *K*, appear to be rather high.

On the whole, the paper adds fresh evidence in favour of the mass-luminosity relation. The individual parallaxes are printed for all the stars with determined orbits. They are especially useful for the smaller parallaxes; for the larger ones the trigonometrical values are more trustworthy.

Research Items.

KENT'S CAVERN.—In the *Proceedings of the Torquay Natural History Society* for 1926–27, Sir Arthur Keith describes the fragment of a human jaw which was found at a depth of 10½ feet in the cave earth in the vestibule of Kent's Cavern. It represents part of the right half of the upper jaw, and includes the alveolar process from the middle of the socket of the canine to almost the hinder or distal margin of the socket of the second molar. Three teeth are in place —the right canine, the second right premolar, and the first right molar. The sockets for the first premolar and the second molar are empty, their teeth having fallen from the sockets after death. A small area of the lower wall of the sinus maxillaris and the basal part of the zygomatic ridge of the upper jaw are preserved, as well as a small part of the palatal process on the inner margin of the alveolar process. There is no sign of disease, but the crowns are worn flat and smooth so that a border of enamel encloses the exposed dentine. The state of the canine indicates an edge-to-edge bite. The condition of the fractured surface of the bone suggests that it was broken away before the animal matter had entirely disappeared. The bone is coloured a pinkish red, the colour of all fossil specimens from the cave earth, and there can be no doubt that it is as old as the date of the deposition of the cave earth. The teeth and jaws may very well have belonged to the same people whose remains have previously been found in the cavern, that is, the palate found in the stalagmite by Mr. Pengelly and the fragment described in the last report. It belongs to the type of modern man which includes the late palæolithic peoples of Europe.

ARGENTINE ROCK-PAINTINGS.—Among the papers presented to the twenty-first International Congress of Americanists at the Göteborg session was a study of Argentine rock-paintings by Mr. G. A. Gardner, which has since been published with illustrations in the *Proceedings*. Although rock-paintings were known to exist in the Province of Cordoba, Mr. Gardner, in the course of investigations extending over three seasons, was able to visit and record a large number which had not previously been described. The paintings are found along the back walls of shelters eroded from the exposed edges of the horizontal strata of the triassic sandstone occurring among the mountains of Cordoba. The individual figures which compose the paintings number more than nine hundred and consist chiefly of natural objects and designs of a geometrical character. Many are incomprehensible. The commonest geometrical figures are circles, but there is a number of rectangular figures resembling gratings, while others are not unlike the European palæolithic 'tectiforms.' Combinations of dots and strokes, suggesting tallies, are found, and some figures may represent human footsteps and animal footprints. The natural objects consist largely of animals drawn in a realistic manner, of which some are the llama or the huanaco, and undoubted canines and felines. Birds are scarce but lifelike. Reptiles are represented by serpents, highly conventionalised, and a few tortoises. Recognisable vegetable forms are almost entirely absent. The absence of the human figure in most shelters was remarkable. They occurred in rudimentary and conventionalised form. A few were highly realistic, showing the dress and weapons of the Indians. Finally, representations of men on horseback appeared, clearly Spanish soldiers. Foot-soldiers are also shown. Few of the figures are in outline, most being silhouetted in colour laid on flat. Superposition is noticeable. They clearly extend over a very long time, and probably ceased with the loss of independence of the Comechingons, as these Indians were known to the Spaniards, soon after the Conquest.

SCOTTISH SEA TROUT.—As a result of the continuous work being carried out by the Scottish Fishery Board on salmon and sea trout, Mr. G. H. Nall has collected information about the sea trout from the tidal waters of the Don and Ythan (*Fisheries, Scotland, Salmon Fish.*, No. II., 1927. London: H.M. Stationery Office), both of which rivers flow out on the Aberdeenshire coast, the former with a tidal estuary one mile long, and the latter with one four miles in length. Recapture of marked fish has shown that in 1926 the sea trout present in the Don estuary were 95 per cent. finnock, and consisted for the most part of fish wandering from other rivers, only a few being natives of the Don. Interesting movements of the trout were disclosed, one having travelled in eight months a distance of 165 miles by the coast line from the Ythan to the River Teith at Callander, in which river perhaps it was originally born. In marked contrast to the mixed population in the Don waters were the fish in the Ythan estuary, nearly all of which were natives of the Ythan river. Collections in this estuary were spread over the whole of 1926, and a review of the changing composition of these trout according to age is given. The writer adds a word of warning against the danger of depleting the stock of the Don and other rivers by anglers who capture thousands of finnock from the Don estuary, many of which in the spring are ill-conditioned fish. Amongst other interesting observations is the effect of the difference in type of west coast and east coast rivers at their junction with the sea on the feeding of the sea trout, which is reflected in their scales. A new departure is made by writing this paper in non-technical language, for the advantage of anglers interested in sea-trout life.

AERATION OF AQUARIA.—The attention of those who desire to maintain aquaria and to provide for their aeration is directed to an account, by Prof. H. Graham Cannon and Dr. A. J. Grove, in the December issue of the *Journal of the Royal Microscopical Society*, of a simplified apparatus which has proved efficient in use. The clear description and two text-figures will enable anyone who has even a moderate amount of technical skill to make and put together the apparatus. The principle is that previously employed in the apparatus of Gemmill, namely, that water from a tap flows through a tube into the horizontal arm of a ⊣-tube and down the lower vertical arm sucking in air through the upper vertical arm. The suction tube in this apparatus, instead of being straight as in the previous types, has upon it near the top a complete twist, and " it is an advantage for this twist to be badly made " and to contain " one or two constricted bends such as the ordinary amateur glass-worker manages to produce." This apparatus should prove useful in many biological laboratories.

THE SPECIES OF ANCYLOSTOMA.—B. Schwartz (*Proc. U.S. Nat. Mus.*, vol. 72, Art. 1, 1927) has made an examination of specimens of *Ancylostoma pluridentatum* and confirms the validity of the species. Abnormalities in the teeth in the mouth capsule are recorded—the outermost teeth on the dorsal wall of the capsule being in some cases truncated and resembling those of *A. braziliense*, but the author considers the two species to be distinct. He gives

a brief review of the species of Ancylostoma and a key by the help of which they may be differentiated. He points out that the teeth in the ventral portion of the mouth capsule are three pairs in some species (e.g. *A. caninum*); in other species (e.g. *A. duodenale*) the innermost of the three teeth is small or rudimentary; in others (e.g. *A. malayanum*) only two pairs of ventral teeth are present; and in *A. pluridentatum* and *braziliense* the inner pair is reduced in size and in some examples of the latter species is entirely absent, there being only a single pair of ventral teeth.

A PARASITE OF THE EGG OF THE LIVER FLUKE.—Prof. J. Bayley Butler and J. J. C. Buckley describe (*Sci. Proc. R. Dublin Soc.*, vol. 18, No. 45, 1927) the occurrence of a Chytridiacean parasite, *Catenaria anguillulæ*, in the eggs of the liver fluke, *Fasciola hepatica*, kept in tap-water in laboratory cultures. The source of the Catenaria is believed to be the tap-water employed. The infection of the fluke egg takes place by a zoospore of Catenaria settling upon the egg-shell and piercing it obliquely, making an aperture about 0·5μ in diameter. The penetration takes place within twelve hours from the settling of the zoospore. The zoospore after entering enlarges to form a subspherical cyst from which a mycelial filament grows out into the contents of the egg and develops a series of enlargements which vary considerably in shape. The intervening unswollen parts of the mycelium become septate and form isthmuses. The enlarged parts—the sporangia—develop nutritive rhizoids which may branch. Within the sporangia, zoospores are formed and eventually escape through a dehiscence tube or beak which usually pierces the egg-shell or pushes open the operculum of the egg. No form of sexual reproduction and no resting spores have been observed. The eggs of the liver fluke will continue to live and to hatch out into miracidia if kept at laboratory temperature for a period of nine months. At any time during this period miracidia can be obtained by placing some of the eggs in test tubes in water in an incubator at 24° to 26° C. Eggs infected with Catenaria would not develop. The possibility of using Catenaria as a means of checking the infection of snails by miracidia is suggested.

ASCENT OF SAP IN TREES.—Before the recent meeting of the American Botanical Society, Dr. D. T. MacDougal, Prof. J. B. Overton, and Prof. G. M. Smith described some experiments on the passage of water up the trunks of trees (*Daily Science News Bulletin*, by Science Service, Washington). They conclude that the wood vessels in the sap-wood of trees, assumed to be wholly devoted to carrying water upwards to the leaves, are to some extent air reservoirs. These air-containing vessels are, moreover, not scattered at random, but have a definite zoned arrangement which differs in different species of trees. Investigations were carried out by injecting red dye into various kinds of trees and either letting the natural suction of the leaves pull it up or pulling it up by a vacuum pump. When the suction applied was small, the dye travelled up the trunk in a natural way, and of course did not enter the vessels blocked by air. The zone of transport was thus clearly marked in red. By this means it was found that in willow the sap stream passed exclusively through wood formed late in autumn, in alder in the early spring wood only, and in walnut through the inner and outer faces of an annual ring, but not through the median portion.

SERPENTINES OF THE SHETLANDS.—Dr. F. C. Phillips makes a noteworthy contribution to the local geology of a somewhat inaccessible region, and to the general problem of the transformations undergone by ultrabasic rocks, in a paper published in the *Quar. Jour. Geol. Soc.*, pp. 622-652, 1927. The Unst intrusion, which is the largest studied, ranges from dunite and peridotite through pyroxenite to gabbro, the latter being penetrated by pegmatoid gabbro. Disseminated, banded, and massive varieties of chromite occur in the more basic serpentines, and form workable deposits. The differentiation series is thus of a normal character, and is referred to primary crystallisation *in situ*. Autometamorphism brought about serpentinisation of the ultrabasic rocks, amphibolitisation of the pyroxenes, and saussuritisation of the felspars. Dynamic action is considered to have contributed to the metamorphism at two stages: contemporary stress to the genesis of antigorite; and subsequent stress to that of various schistose products. The formation of carbonates is referred in part to the action of atmospheric weathering.

CORAL REEFS AND A MIGRATING ANTICLINE IN FIJI.—The Fiji Islands include examples of fringing, barrier, and atoll reefs in all stages of growth, and elevated barriers and atolls in various stages of dissection. The region has therefore played a considerable part in the coral-reef controversy. In the *Amer. Jour. Science* for November last, Prof. W. M. Davis uses it to show that despite many weighty opinions to the contrary, its evidence may still be unequivocally in favour of Darwin's theory. He shows that four or five roughly north-south belts of unlike reefs can be recognised, and he describes the vertical movements which the islands of each belt have suffered. It is found that the phases of movement of the western belts occur later than the corresponding phases of belts to the east. This suggests the westward propagation of a broad and shallow wave-like deformation of the ocean floor. The observed changes of level thus appear to be equivalent to the slow westward migration of a broad anticline preceded and followed by shallow synclines. The wave-length is to be measured in scores of miles, but the height from trough to crest is only a few thousand feet. This remarkable hypothesis co-ordinates in a very simple fashion a large variety of observations which hitherto have given a hopelessly confused picture of the history of this unstable region. Prof. Davis finds that the adoption of his scheme of a migrating anticline at once removes all the difficulties which Darwin's coral-reef theory has had to encounter in Fiji. He concludes, " . . . in spite of the many obituaries written over it in the past forty years, it may be expected to regain in the coming half-century the worldwide acceptance that it enjoyed for a generation a hundred years earlier."

OPAQUE MEAL FOR X-RAY DIAGNOSIS.—We have tested a sample of a new barium meal preparation for X-ray diagnosis prepared by the British Drug Houses, Ltd., and supplied under the name 'Shadoform.' It is put up in boxes containing the equivalent of 4 oz. chemically pure barium sulphate specially prepared, so that it forms, when mixed with cold water, a fine suspension with no tendency to settle, as the cruder forms of barium sulphate are apt to do. A little care is necessary in mixing with the water to form a suspension free from lumps, but if the instructions are followed a very good mixture results, which is palatable and of a smooth texture. The definition on the screen is good, and the meal can be manipulated easily while in the stomach. No tendency of the opaque material to settle was noticed, and excretion appeared to be satisfactory. The material is stated to be chemically pure, and hence no possibility of absorption

of barium salts will arise. In this material we have a satisfactory meal which can be quickly made up.

SCATTERING OF ELECTRONS IN IONISED MEDIA.—The article by Dr. I. Langmuir in the *Zeitschrift für Physik* of Dec. 14 on electric discharges in gases at low pressures, is a valuable review of some of the advances of recent years for which he has been directly or indirectly responsible. His methods for measuring potentials, and ionic concentrations and energies, are by now well established, and have been applied to numerous problems, but there is the curious outstanding difficulty that groups of electrons acquire a thermal distribution of velocities far more readily than can be accounted for by collisions of any ordinary type. Dr. Langmuir gives reasons for supposing that the apparent scattering cannot be an effect of either regular or aperiodic fluctuations of the discharge, as has been suggested by other authors, but the exact mechanism by which it takes place is still obscure. A large number of numerical results has, however, been collected by now, and it appears probable that the process is reversible, and that the agent responsible, whatever its nature, is in a species of thermal equilibrium with the electrons affected.

SPACE CHARGES IN ELECTROLYTES.—Various aspects of the electrical convection of liquids, many of them known to Warburg and other earlier workers, are discussed by Prof. A. Coehn and Dr. Schnurmann in the *Zeitschrift für Physik* of Jan. 2, their object being to extend the analogy between conduction in gases and in liquids. The latter usually contain ions in such large numbers that many phenomena typical of the former are masked, but the correspondence is closer with electrolytes of one thousandth or less normality, and is especially prominent in the large fields near the surfaces of small sheathed electrodes. Here the differences in mobility of the positive and negative carriers are sufficient to set up a space charge, which can give rise to a motion of fluid *towards* the electrode. A particularly neat experiment that is described shows this effect, as well as the analogue of the electrical wind, by the reaction on a light enamelled wire, suspended in millinormal sulphuric acid with its lower end bent round, and only the extreme tip serving to give electrical connexion between the metal and fluid.

HUMIDITY TEST EQUIPMENT.—The amount of moisture in the atmosphere has a great effect on the mechanical and electrical properties of all fibrous materials. It is therefore to be expected that telephone apparatus connected to miles of insulated circuits and having closely adjusted moving parts should be specially susceptible to the effects of moisture. It is necessary for telephone laboratories to have humidity test departments where the effect of various percentage humidities in the atmosphere can be accurately studied. E. B. Wood, in the *Bell Laboratories Record* for December, describes the facilities this company has in its development laboratory for making humidity tests. The equipment consists of large cork insulated rooms, small air-tight chambers, and smaller portable units. The large rooms have a capacity of about 1500 cubic feet. The temperature and humidity of each room are controlled by a system of sprays, water-cooled radiators, and electric heaters, the air from a centrifugal blower circulating through them. This apparatus enables the humidity to be kept constant at any value from 30 to 95 per cent., and the temperature at any value between 70° and 110° F. This covers the range of conditions usually existing in telephone buildings. The operation is automatic, the humidity being maintained with one per cent. accuracy and the temperature to within half a degree Fahrenheit. It is thus easy to test both raw materials and large pieces of apparatus under various operating conditions. The smaller test chambers are thoroughly heat-insulated from the outside. The humidity is controlled by the use of a solution of sulphuric acid contained in a large shallow lead tray over which the air is circulated by a fan. For temperatures below room temperatures, air cooled by contact with ice is circulated by an electric blower. For very accurate tests or for tests like corrosion tests which require a long exposure, these chambers are used. The portable units have a capacity of about eight cubic feet and are used for the inspection testing of raw materials and small manufactured articles.

REICHERT MICROSCOPES AND ACCESSORIES.—In a recently issued catalogue (List E 7), Messrs. C. Reichert of Vienna give a description of various types of their microscopes and photomicrographic apparatus for biological and mineralogical purposes. Several models of the new mono-binocular stereo-microscope are illustrated. In this instrument, the pencil of light from the objective is equally distributed between the two oculars by internal reflection from a silvered prism. The silvering is thinner on one half of the reflecting surface than on the other. This gives rise to a difference between the intensity of the rays in the left half and that in the right half of the ocular receiving the reflected portion of the light. The conditions are exactly reversed in the other ocular, which receives the light transmitted through the partially silvered surface. The parallactic differences thus produced in the pictures presented to the two eyes give rise to the stereoscopic effect. This effect is obtained without the loss of light which is involved when part of the pencil of light has to be screened off. A series of F/4 anastigmat lenses suitable for macrophotography or projection is also listed in the catalogue. These give magnifications of from 4 to 24, with focal lengths of 100 mm. to 20 mm. respectively. Amongst the various types of vertical illuminators illustrated is a polarising illuminator which can be screwed on to the microscope tube when it is desired to examine metals or ores under polarised light. The illuminator embodies a rectangular illuminating prism, a rotating polariser, illuminating lenses, filter slot, and an electric bulb as the source of light. The catalogue also includes a wide range of objectives, eyepieces, condensers, and other microscope accessories made by Messrs. Reichert, whose London agents are Messrs. Chas. Hearson and Co., Ltd., 27 Mortimer Street, W.1.

BABYLONIAN ARTIFICIAL LAPIS LAZULI.—In the *Chemiker-Zeitung* of Dec. 31, Prof. Neumann gives an interesting account of some analyses which he has recently carried out of fragments of Babylonian *artificial* lapis lazuli, dating from about 1400 B.C., from the excavations at Nippur. The high percentage of lead previously found by Bertrand has been shown to be quite erroneous, but it has been conclusively established that both cobalt and copper are present as colouring matters. It is claimed that this is the only antique glass which is definitely known to be coloured by cobalt, for in spite of frequent references in technical literature to the existence of this metal in antique glasses, they appear to have no justification. Their origin has now been traced to a faulty observation published by Davy in 1815. Although many specimens of antique glasses from the period between 1500 and 850 B.C. have been analysed by Neumann and his collaborators, cobalt has hitherto never been detected in them.

The Genetics of Cereals.

THE volume of published investigations on the genetics and cytology of cereals continues to increase, and some important problems of variation and relationships in these forms are being solved. One of the most recent of these discoveries relates to oats.

The sporadic origin of fatuoid or false wild oats from cultivated varieties has been an agricultural problem for forty years. They resemble the wild oat, *Avena fatua*, but differ in not having delayed seed-germination. An extended study of the genetics and cytology of fatuoids by Dr. C. L. Huskins (*Jour. of Genetics*, vol. 18, No. 3) has resulted in the important discovery that these are mutations resulting from chromosome irregularities in normal oats. While ordinary oats (*Avena sativa*) has forty-two chromosomes, Dr. Huskins has found that in different fatuoid strains the chromosome numbers range from forty to forty-four.

The commonest type of heterozygous fatuoid has forty-two chromosomes and segregates into normals, heterozygous and homozygous fatuoids in a 1 : 2 : 1 ratio. The segregated fatuoids frequently have a single trivalent and a univalent chromosome or, in homozygous forms, a quadrivalent. Probably such fatuoids arise through the formation of a quadrivalent chromosome in which the elements are not segregated in their proper pairs in the reduction division. Another fatuoid type has forty-one chromosomes and produces a few sterile dwarfs with forty chromosomes. The type with forty-three chromosomes produces a few sterile dwarfs with forty-four.

This work constitutes a new and striking case of correlation between chromosome content and genetic behaviour. Numerous similarities are pointed out between fatuoid oats and speltoid wheats, which also arise as variations. Both conditions apparently arise through aberrant chromosome distributions. The practical possibility is suggested that a strain of oats may be produced which does not give rise to fatuoids.

Novel results are obtained by Mr. A. E. Watkins (*Jour. of Genetics*, vol. 18, No. 3) in the study of crosses between Rivet wheat (*Triticum turgidum* with 14 pairs of chromosomes) and *T. vulgare* (vars. Yeoman and Iron) with 21 pairs. The F_1 is partially sterile, but was back-crossed with both parents reciprocally. Chromosome counts in these hybrids show that while the F_1 fertile egg-cells usually have a chromosome content intermediate between 14 and 21, the F_1 pollen grains with intermediate numbers are largely sterile. Thus while the eggs tend to be genetically intermediate, the 14-chromosome pollen grains are found to be carrying chiefly the *turgidum* characters, while the pollen with 17-21 chromosomes carries mainly *vulgare* characters. The keel on the glume, which distinguishes *turgidum*, can be transferred to *vulgare* by crossing. The view is expressed that there are not many factor differences between the *turgidum* chromosomes and the 14 *vulgare* chromosomes with which they pair, the *vulgare* characters being associated with the extra chromosomes. The view is therefore upheld that there is a simple polyploid relationship between the two species.

The interesting discovery is made that in some of these back-crosses the germination of the grain is largely determined by the chromosome content of the endosperm. Grains from the cross 42-chromosome ♀ × 28-chromosome ♂ are plump and germinate well, while from the reciprocal cross they are wrinkled and germinate badly. Successful germination depends on the relations between embryo and endosperm. The conclusion is reached that germination is good if all chromosomes are present in the endosperm in the diploid or triploid condition, but bad when some of them are only represented once.

In a continuation of this work (*Jour. of Genetics*, vol. 19, No. 1), Mr. Watkins has studied the inheritance of such features as waxy leaves, keeled glume, and susceptibility to *Puccinia glumarum* in F_1 *T. vulgare* × *T. turgidum* back-crossed with *turgidum* or *vulgare*. The results lead to the conclusion that the two species carry homologous factors in homologous paired chromosomes, while the extra *vulgare* chromosomes carry another set of very similar if not identical factors.

In crosses between the tetraploid *T. durum* and *T. vulgare*, Prof. W. P. Thompson (*Genetics*, vol. 10, p. 285) found in F_2 and F_3 some plants resembling *T. durum*, some like *T. vulgare*, and some intermediate. They have chromosome numbers corresponding to their external appearance, and the forms with intermediate numbers and appearance tend to be eliminated in F_3. The correlation between the *T. durum* characters and rust-resistence was broken, but since resistance evidently depends on more than one factor, it will be very difficult to get full rust-resistance in *T. vulgare* types.

Various crosses between wheat (21 chromosomes) and rye (7 chromosomes) have been made in recent years. Prof. Thompson (*Genetics*, vol. 11, p. 317) describes the cytology of a cross, using an unspecified variety of wheat as mother. This particular cross, he finds, is easily made. In the hybrid, no chromosomes pair at reduction, but the 28 separate into two groups and split lengthwise either before or after this separation. Very few F_2 plants were obtained, as the pollen sterility is almost complete.

Prof. G. K. Meister and his collaborators at the Saratov Experiment Station on the Volga have published a series of papers on wheat-rye hybrids, beginning in 1918, which should be more widely known. Their most recent contributions in Russian, with English or German résumés, are contained in *Jour. Exp. Agric. S.E. Eur. Russia*, vol. 4, Part I. They find that the reciprocal crosses between *vulgare* wheat (var. *erythrospermum*) and rye can be made, and they give identical results. The rye × wheat cross was made by using the local winter rye and the pollen of a winter wheat. The F_2 from these crosses was grown in large numbers in 1926, and many of the plants showed greatly increased fertility.

The cytology of the hybrid between *T. monococcum* ($n = 7$) and *T. turgidum* ($n = 14$) has been investigated by Prof. W. P. Thompson (*Jour. Genetics*, vol. 17, No. 1). In the pollen formation of this triploid hybrid, three to seven bivalent chromosomes appear, the remainder being unpaired. Sax, using another variety of *turgidum*, has previously reported the regular occurrence of seven bivalents. The later history of the chromosomes is also different, Thompson finding that after the bivalents separate the univalent chromosomes arrange themselves medianly and split. In the homotypic division these univalents lag, fail to divide, and wander irregularly to the poles. Sax, however, found the univalents dividing in the second division and not in the first. Thus a small difference in one of the parents appears to make a great change in the chromosome behaviour. These two varieties of *turgidum* ought to be crossed together and the hybrids studied.

Reference may be made to one more paper on wheat hybrids, by Miss Melburn and Prof. Thompson (*Amer. Jour. Bot.*, vol. 14, p. 327). In *T. spelta* ($n = 21$) × *T. monococcum* ($n = 7$) the hybrid is completely sterile, and the heterotypic division shows from five to no bivalent chromosomes. The remainder mostly split, but in the second division they lag and form extra nuclei. The hybrids between different types of wheat can thus be arranged in a series according to the amount of pairing of chromosomes and the irregularities in the behaviour of the univalents.

R. RUGGLES GATES.

The Introduction of Civilisation into Britain.

AT the anniversary meeting of the Royal Anthropological Institute, held on Tuesday, Jan. 24, the outgoing president, Mr. H. J. E. Peake, delivered an address on "The Introduction of Civilisation into Britain." He said that it seems certain that the art of agriculture, the first step in civilisation, was first practised in the Near East, more probably in Asia than in Africa, and that the first grain-growers were also potters. At an early date both these arts were introduced into the Ægean area and into the Plain of Hungary, and Prof. Childe has shown how they spread from the latter area to Switzerland, to the Rhine, and to the country around Liège.

Dr. Frankfort has recently pointed out the existence of a trade-route in Early Minoan times; this started from the head of the Gulf of Corinth and reached southern Italy and Sicily. Along this route passed commodities from the second city of Hissarlik. Frankfort suggests that this trade was carried farther west, and Childe has noted the presence of Early Cycladic beads in Portugal. This indicates that the elements of civilisation had reached the Atlantic coast before 2200 B.C.

Prof. Bosch-Gimpera has shown that early in the Copper Age there were two small centres of civilisation in the Iberian peninsula, one at Almeria in the south-east and the other in the south of Portugal, and that between them the Capsian natives used a rough pottery, based on leather models. These people had evidently learned the first elements of civilisation from the eastern traders, and had developed a rude civilisation that Bosch-Gimpera calls "la civilisation des grottes." He has also shown that this type of rude pottery spread so far as the Maritime Alps.

It is believed that agriculture and the potter's art reached Britain at the dawn of the Neolithic Age, and this view, as we shall see, is justified. In 1910, Mr. Reginald Smith described some round-bottomed bowls, one of which came from Mortlake, and some similar fragments from Peterborough, and pointed out that pottery of that type has been found in Finland and East Sweden. In 1925, Mr. T. D. Kendrick described two neolithic wares, one of which was found at Rodmarton and other sites in Gloucestershire and Wiltshire, the other at Mortlake and Peterborough, and in the same year Prof. O. Menghin also described these wares under the names of *Grimston-keramik* and *Peterborough-keramik*, suggesting that the former is earlier than the latter. Quite lately Mr. E. Thurlow Leeds has discussed the problem, criticising Menghin's terminology, and claiming that the first ware arrived from the south and the second from the north-east about the same time.

The best evidence comes from Windmill Hill, Avebury, now being excavated by Mr. Alexander Keiller, who has kindly allowed this information to be published. Here have been found three concentric rings of intermittent ditches, resembling those at Michelsberg, but without the distinctive tulip-shaped vase of the latter site. Pottery was found abundantly in the ditches, but in two layers separated by an almost sterile interval.

In the top layer, along with fragments of beakers, were found a number of pieces of the *Peterborough-keramik* and many sherds resembling the *Grimston-keramik*. In the lower layer, however, the prevailing ware is different, but the paste somewhat resembles that of the *Grimston-keramik*. Mrs. Keiller has restored several pots, which resemble closely some found in the lake-dwellings of Switzerland, and are called by Reinerth the *Westische-keramik*; these seem to have been introduced into Switzerland from the basins of the Rhone or Saône.

It appears likely that the elements of civilisation passed up the Rhone valley into Burgundy, where this *Westische-keramik* developed among a people who lived in fortified villages of the Michelsberg type. Thence the potter's art, and the elements of agriculture, spread into Switzerland, through the Belfort Gap into the Upper Rhine basin, where it developed into the characteristic Michelsberg type, and into the north of France and Belgium, where it spread over a large area, in which was a culture called by Bosch-Gimpera "la civilisation du silex." From this last region it reached the south of England some little time before the arrival of the *Peterborough-keramik* on the north-east coast.

Marine Oil-Engines.

IN the first Thomas Lowe Gray lecture, delivered before the Institution of Mechanical Engineers on Jan. 6, Prof. C. J. Hawkes makes an interesting survey of the past development, present status, and probable future development of the marine oil-engine. Past development is but briefly outlined. In regard to the present position, attention is directed to the fact that recent improvements in fuel consumption of marine steam turbine installations have reduced the advantage in this respect held by the oil-engine. In the tests conducted by the Marine Oil-Engine Trials Committee, the Still airless-injection two-stroke engine, consuming 6880 B.T.U., and the Doxford airless-injection opposed piston two-stroke engine, consuming 7570 B.T.U. per brake horse-power per hour, were the best performances, and it is shown that while the former has a less efficient fuel combustion, this is more than balanced by the energy recovered from the jackets and exhaust gases. It is estimated that the minimum consumptions possible at the present time are 6240 and 6820 B.T.U. per brake horse-power hour for the Still and Doxford engines respectively.

In a discussion of possible improvements it is regarded as doubtful whether the installation of waste heat boilers for the purpose of increasing the overall efficiency is justifiable. The employment of high speed engines transmitting power through hydraulic clutches and mechanical gears, which effects a saving in weight, etc., is considered to be limited to four-stroke trunk-piston engines of moderate power. The four-stroke single-acting engine has much to recommend it for moderate powers, and for larger powers, the two-stroke single acting is preferred to the four-

stroke double-acting engine, the former being less complicated than, and at least as efficient as, the latter. For still larger powers the two-stroke double-acting engine is considered to be the logical line of development. Experimental engines of this latter type are being tested, and it is to be expected that a reliable two-stroke double-acting engine will be produced. There are difficulties involved in applying the oil-engine to high-powered war vessels, and a warning is expressed against applying it indiscriminately or without full consideration of its suitability for the service.

The most important stresses to which the liners, pistons, and covers are subjected are those resulting from temperature, and the real safe continuous power rating of an internal combustion engine is therefore largely dependent upon the heat flow through the liners, etc. The maximum power which can safely be developed thus depends upon the working fluid temperatures, and in order to limit the latter without reducing the mean pressure, attention must be given to the efficiency of combustion and volumetric efficiency. The efficiency of combustion is mainly dependent upon the shape of the combustion space and the movement of the air within that space. A compact combustion space is desirable, as this enables a lower compression ratio to be adopted, and the hemispherical-cavity form is considered to be the best. Whether airless or blast injection is adopted, any movement of the air in the combustion space which causes the globules of fuel to collide with each other or with the walls of the combustion space is to be avoided.

If two engines develop the same mean pressure, that with the lower volumetric efficiency must necessarily be hotter. The crank case engine is a very simple type, but it has a low volumetric efficiency and is consequently a hot and low duty engine. The four-stroke engine has a higher volumetric efficiency than the two-stroke engine because of its more effective scavenging. The introduction of port scavenging simplified the two-stroke engine at the expense of volumetric efficiency, but recent improvements have largely counteracted this. In four-stroke engines the opposed piston type is considered to have nearly as high a volumetric efficiency as the single-piston engine. Heating the induction air has an adverse effect upon volumetric efficiency. Supercharging is receiving considerable attention, but its adoption will only be justifiable if it enables higher mean pressures to be attained without increasing cycle temperatures.

Direction Finding in Navigation.

IT is of great importance to aircraft to know exactly the direction in which they are travelling, and hence direction-finding equipment has been elaborated. This not only takes up much of the limited space available but is often also difficult to operate. The Air Ministry has recently developed a new method of direction finding in its design establishment at Biggin Hill. This was described on Jan. 4 to the Institution of Electrical Engineers by Messrs. T. H. Gill and N. F. S. Hecht.

The chief object of the method is to replace the direction-finding equipment on the aircraft by something very much smaller and easier to operate. A loop aerial is employed at the station, the energy radiated from the loop being a maximum in one direction and a minimum in another. The loop rotates about a vertical axis at a speed of one revolution per minute and sends out a continuous signal. This signal is interrupted when the line of minimum radiation is in the true north direction and a special Morse signal is transmitted at that moment. This enables the observer to start a chronograph. He can then find the interval between the north signal and the instant at which he is receiving minimum radiation. He thus obtains his bearing.

From the results obtained it was found that bearings could be determined with an accuracy at least equal to that obtained by any other radio method of direction finding. For the accuracy necessary for aerial navigation, this method gives a range of 200 miles.

The Air Ministry having found the 'rotating beacon' method of great use for aircraft, the Radio Research Board has made a series of experiments to find out if it would be equally useful for navigation. The results of these experiments were communicated to the Institution of Electrical Engineers by Messrs. R. L. Smith-Rose and S. R. Chapman at the same meeting.

The rotating-loop beacon was installed near Gosport and a calibration was carried out at fixed points in various directions up to a distance of 60 miles. It was found that the observed bearings were subject to a permanent deviation due to land effects. This permanent deviation was not greater than one or two degrees. At distances exceeding 60 miles, radio bearings got by this method were found to be subject to night effects similar to those obtained in radio direction finding. The errors were not serious, however, until the range exceeded 90 miles oversea. Even at great distances a fair accuracy can be obtained by taking the average value of a series of readings made in about ten or fifteen minutes. It was concluded that, up to 50 miles, the rotating beacon method gives accurate readings.

Compared with the ordinary direction-finder as used on board ship, this method has several advantages. It is independent of the steadiness of the ship, and also of the accuracy with which the ship's head is given by the compass reading at the instant of observation. No correction or compensation corresponding to the quadrantal error associated with the ship's direction-finder is necessary. It was proved, however, both theoretically and experimentally, that the limitation of the accuracy by night effects applies equally to both methods.

School Natural History.

THE annual report of the Marlborough College Natural History Society, the 75th in series, shows evidence of considerable vigour under the presidency of Mr. L. G. Peirson, who is clearly a naturalist of wide attainment. The area of work is defined as ten miles from the College as centre. All the various sections (Astronomy, Archæology, Ornithology, Botany, and Entomology) seem to have vigorous boy members with to each a master having the same hobby. This year the most notable record is that of 558 species and varieties of flowering plants —evidence of close raking, though the surrounding country is singularly varied with its forest and great downs, its chalk hills and lands of high cultivation, its water meadows and valleys of rocks. It is the only place where the Icterine Warbler has been

known to breed in England, and perhaps this is true of the Sand Grouse, which once seemed to bid fair to become a permanent resident of Martinsell, drinking from its dewponds.

The Society as its serious task records the meteorology of its area, the dates of flowering of plants, of appearances of all kinds of insects, and of the laying of eggs by birds, with other similar information. The splendid old records of Preston and of Smith, of Everard im Thurn, and above all of Edward Meyrick, allow comparisons of the organisms of forty to fifty years ago with those found to-day; but they are to some degree deceptive, as the area for intensive study was practically ten miles in diameter then, while it it is now twenty. For purely scientific purposes there should be subdivisions into ecological regions, and this is being attempted by similar societies elsewhere. We believe, however, that boys are gregarious creatures and prefer mass rather than individual studies, and that such changes, if forced, may drive the work entirely into the hands of masters —an action which would kill the object of the Society to suggest natural history to the greatest number of boys as likely to be a delightful hobby in after life.

Clearly, with the boys as first object in view, the Society no longer publishes the research work of one of the masters—A. G. Lowndes—but this is a gain to science, not a loss, as it is readily accepted in specialist journals. He and his pupils keep and breed many animals and plants from ponds, playing with the *p*H of the water and attempting to correlate form with its variation. The technique is excellent, and Lowndes's work, in proving the negation of Labbé's results on many species of Cyclops, is important. To the boy a live animal is the thing, and we should like to see more records of the keeping and breeding of insects, worms, snails, and all invertebrates in the records of the different sections; indeed, we hold that the museum of every natural history society requires a separate gallery for such work on living animals, and we believe it would prove the popular section of its exhibits.

University and Educational Intelligence.

CAMBRIDGE.—Mr. W. B. R. King, Fellow of Magdalene College, has been awarded the Sedgwick Prize for an essay on "Contributions to the Geology of some District in which Sedgwick worked." The subject announced for the next award is "A Petrological or Stratigraphical Study of a Rock Group."

EDINBURGH.—At a meeting on Jan. 23, the University Court received, with very great regret, intimation from Sir James Walker of his intention to retire from the chair of chemistry at the end of the current academical year. It was resolved to record the high appreciation of the Court of his long and distinguished service to the University.

The status of University lecturer was conferred upon Dr. Alexander Lauder, head of the Chemistry Department in the Edinburgh and East of Scotland College of Agriculture, in recognition of the responsible part which he has long taken in the teaching of chemistry in the curricula for degrees in agriculture and forestry.

The Court received with gratification intimation of a bequest by the late James Sanderson, Galashiels, of five shares of the residue of his estate, to be applied for the advancement or promotion in the University of technical and scientific study and research in the chemistry and engineering branches of the Faculty of Science. The amount of the bequest is estimated at about £35,000.

The offer was accepted of an endowment contributed by former students and others associated with the work of emeritus Prof. Robert Wallace, for the foundation of a University prize, to be known as the "Wallace Prize," to be awarded to the best degree student of the third year in agriculture not holding a Vans Dunlop or Steven Scholarship.

NOTTINGHAM.—In view of the fact that the new buildings, which are being erected by Sir Jesse Boot, Bart., in the University Park, will be opened by H.M. the King in July next, the authorities of University College are contemplating in the near future an appeal to increase the endowment fund of the College. Two members of the Council of the College, Mr. H. F. Lancashire, J.P., and Mr. G. Spencer, J.P., have announced their intention of endowing a chair by a joint gift of £20,000. Mr. Lancashire, who has been on the Council of the College since 1917, and was in 1926 elected a vice-president of the Court of Governors, is managing director of Messrs. J. B. Lewis and Sons, Ltd., hosiery manufacturers of Nottingham and Ilkeston. He took an active part in the reorganisation of the Textiles Department of the College in 1920, and has been for some years chairman of the Textiles Advisory Committee. It is no doubt due to his untiring energy that University College, Nottingham, now possesses possibly the finest hosiery laboratory in Great Britain. Mr. George Spencer, who was elected a member of the College Council in 1923, is head of the firm of Messrs. George Spencer and Co., hosiery manufacturers, of Nottingham, Hucknall, and Lutterworth. Mr. Spencer has for many years taken a great interest in the work of the College, and is one of the two trustees of the Revis Bequest, whereby the College acquired a sum of approximately £49,000, the interest on which is to be devoted to the provision of scholarships and studentships.

The new buildings occupy a commanding position in the new University Park, and will provide accommodation for the Faculties of Arts, Pure Science, and Economics and Commerce. The Applied Science Faculty will remain at the old building in Shakespeare Street, with the exception of the Heat Engines Laboratory connected with the Engineering Department, for which provision is being made in a special block of the new buildings. A hall of residence, accommodating eighty women students, is being erected in the University Park, and it is hoped that this will be ready for occupation during the ensuing session. The playing fields of sixteen acres are situated in the Park, within a few minutes' walk of the University and the Hostel. Sir Jesse Boot bore the cost of the laying out of these, and also of the erection of the sports pavilion and the women's hostel.

OXFORD.—It is understood that during the next two terms the problems presented by the congested state of the Bodleian Library will be seriously considered by the Hebdomadal Council. The principle of separate faculty libraries has already been accepted in the case of Law and Natural Science. Novels are shelved in cellars far removed from the main library, so there are precedents for the separation of that vast mass of 'deposited' literature, much of it of doubtful value, that at present dilutes, and renders difficult of access, the more valuable portions of the library.

A lecture delivered on Jan. 26 on "Isocrates in England" in ancient Greek by the Public Orator is in the nature of a revival of a lecture founded in 1583, the year in which Galileo watched the pendulum in the Duomo at Florence. It was noticeable that the lecturer does not include natural science among the subjects to be taught to boys between 16 and 18 years of age; evidently pendulums are still swinging.

Dr. F. A. Dixey, late Sub-Warden, Wills Medical Fellow and Bursar of Wadham College, has been elected to an emeritus fellowship.

Calendar of Customs and Festivals.

February 5.

ST. AGATHA, martyred at Catania under Decius by the governor Quintianus. She was miraculously healed of the wounds inflicted on her by torture, by the apostle Peter, who appeared to her carrying a vase and accompanied by an angel. After her death, an unknown young man accompanied by a hundred children placed an inscribed marble tablet on her tomb and then disappeared and was never seen again.

February 10.

ST. SCHOLASTICA, a festival formerly observed at Oxford, when the burgesses attended at St. Mary's. The origin of the custom is said to have been a quarrel between the citizens and students of the University which took place on this date in the year 1354. The outbreak lasted for some days, several students being killed; and all the religious crosses of the city were destroyed. For this offence the King, who was then at Woodstock, deprived the city of many privileges, bestowing them on the University, and the Bishop of London forbade the administration of the sacraments to the citizens, a sentence which was not removed until 1357, when a total abrogation was granted on the condition that St. Scholastica's day should be celebrated by a number of masses for the souls of the students, the mayor and bailiffs, with 60 burgesses, being bound under penalty of 100 marks to swear at St. Mary's Church observance of the customary rights of the University. Further, each of the burgesses was to offer individually on the altar one penny to be divided between the poor and the Curate of St. Mary.

SEASONAL FESTIVALS.—In popular tradition and custom there is a tendency to confuse the celebration of St. Bridget's Day with Candlemas. Candlemas observances, such as the kindling of the Yule Log and the dismantling of the decorative foliage, characteristic of winter or the Christmas season, mark the change from one season to another and the passing of winter. St. Bridget celebrates the opening of spring. Both traditions rest on a division of the year by seasons rather than months, and therefore belong to an earlier phase of calendrical arrangement.

It must be remembered that Feb. 1, the date of the feast of St. Bridget, falls twelve days later in the Old Style year than in the revised calendar and is by that much a more appropriate date for the celebration of the coming of spring. The effect of intercalation is seen in popular custom in the belief that, during the early part of the year, especially between Christmas and Twelfth Night, each day of a certain period foretells the weather in the coming year. The Celtic calendar, to reconcile the lunar and solar years, intercalated a thirty days' month in two and a half years, and other members of the Indo-European group followed the same system. In Brittany the last six days of the old year and the first six of the new were known as 'supplementary days.' Each was called by the name of a month, and each prognosticated the weather of the month in the coming year with which it corresponded. It is also a Brahmanic belief that the twelve intercalated days are an 'image' of the coming year.

In the Highlands of Scotland, the survival of the older method of reckoning is seen in the popular system of fixing periods of time by reference to seasons and often in such a way as to cut across the monthly divisions. The Celtic calendar divided the year into four seasons, but there is evidence of an older division into two seasons; one beginning on May 1 at Beltane and the other on Nov. 1 at Samhain, the latter marking the beginning of the Celtic year. Earrach, spring, began on Feb. 1; Foghainhan, the festival of Lughnasadh, the harvest feast, took place on Aug. 1. This festival would appear to be the last to be added to make the fourfold division of the year. That festivals were observed on May 1, Aug. 1, and Nov. 1—the two latter preserved in Lammas and All Souls respectively—is well known, but for the occurrence of a spring festival the evidence rests principally upon what may be deduced from the surviving tradition in the observance of St. Bridget's Day.

The form and divisions of a calendar, together with the ritual observances attached to it, are governed by the occupations of the people or group with whom it originated. The fourfold division of the year derives from the natural divisions into which the changing seasons group the activities of an agricultural community. On the other hand, the year of a pastoral community naturally falls into two divisions, one beginning when the flocks and herds are sent out to graze at the coming of the warm season, and the other when they are brought home at the setting in of cold weather. If, therefore, the Celtic year is correctly interpreted as showing a change from the twofold to the fourfold division, it would point to a corresponding change in occupation from pastoral to agricultural, the ceremonial fires of Beltane on May 1 still being lit for the purification of the flocks and herds before they were sent out to graze.

The twofold division of the year was apparently characteristic of the Aryan-speaking peoples. It appears in the Slavic calendar and also in the Norwegian. The latter is of a very primitive type. It was divided into summer and winter only; the former opened on April 14, and the latter on Nov. 14. There were two great festivals, one in early summer and the second at the beginning of winter, when there is reason to believe the year began.

The association of Candlemas in ecclesiastical tradition with a Roman festival points to a connexion between Christian observance and Roman custom, of which it is not an isolated instance. The impulse towards purification on entering upon a new phase of existence which can be observed in the practices of the New Year, and is of wide distribution, appears in both the Christian and the Roman calendar. Until the reform of Julius Cæsar, the Roman year began in March. The feasts of the Roman calendar in its early form can be traced back to the observances and customs of a primitive agricultural community. As might be expected from a people at that stage of culture, the last month of the old year was a time of solemn purification and of renewal of the spiritual influences which protected the individual and society as a whole. The name of the month of February is said to be derived from Februus, an instrument of purification. The chief feasts of the month were directed to this end. The Terminalia, Feb. 23, renewed the solemn ritual of the placing of the boundary stones. The Parentalia, which lasted over nine days, renewed the bonds between the family and their dead, culminating in a celebration by the whole State on Feb. 21: while the Lupercalia, in a ceremony of which much is obscure, by a solemn procession around the Palatine on Feb. 15, the participants in which were girt with skins, apparently purified the sacred area from evil influences of the past and reinforced its sacred character for the coming year. It is scarcely necessary to dwell upon the resemblance between this period of solemn observance and the Christian Lent.

Societies and Academies.

LONDON.

Royal Society, Jan. 26.—**G. I. Taylor**: The deformation of crystals of β-brass. β-brass, which has a crystal structure similar to that of α-iron, behaves in a similar, though not identical, manner when distorted. The peculiar feature of the distortion of iron crystals, namely, the fact that slip does not occur on a definite crystallographic plane, is repeated in β-brass within a certain range of orientations of the crystal axes in the specimen. On the other hand, in another range of orientations, slip occurs on a definite crystal plane of type {110}. The variation in resistance to shear which occurs as the plane of slip rotates about the direction of slip determines which type occurs. This variation is calculated from the experimental results within the range to which they apply, and it is shown that resistance to shear is least when the plane of slip coincides with a crystal plane of type {110}. On either side of this position shear stress increases linearly.

F. Horton, A. C. Davies, and U. Andrewes: Critical potentials for soft X-ray excitation. An account of an extension of work on the critical potentials for the excitation of soft X-rays from the elements chromium, manganese, iron, cobalt, nickel, copper, and zinc, using steady deflexion methods instead of the ordinary timing method of measuring with the electrometer the photoelectric currents produced by the rays. This greatly facilitated the taking of series of observations, and in consequence additional critical points have been detected. It is suggested that some critical potentials may be characteristic of the arrangement of atoms at the surface of the target, as distinct from others which would be characteristic of encounters between electrons and isolated atoms. At low voltages, the efficiency of soft X-ray excitation is nearly the same for all the elements investigated.

H. Gough: The behaviour of a single crystal of α-iron subjected to alternating torsional stresses. Subjected to alternating torsional stresses, the direction of slip coincides with that of the most highly stressed principal line of atoms, and four such possible directions of slip exist within the crystal, each being parallel to the normal to one of the four set of octahedral planes, and at any point on the circumference of the crystal there exists a plane on which the value of the shear stress on the plane resolved in one of the octahedral directions is a maximum. Slip only occurs on one of the following two combinations of planes: (*a*) 110 and 123, or (*b*) 112 and 123; it cannot occur on a 112 plane combined with a 110 plane.

R. W. James, I. Waller, and D. R. Hartree: An investigation into the existence of zero-point energy in the rock-salt lattice by an X-ray diffraction method. Within certain limits of frequency the F curve, or atomic scattering curve, of an atom for X-radiation can be calculated by applying the classical law of scattering to the distribution of charge represented by the Schrödinger density-distribution for the atom. The F curves calculated from the Schrödinger distributions for the ions Na^+ and Cl^-, obtained theoretically by an approximate method, and those obtained experimentally from observations on the rock-salt crystal at different temperatures, agree very closely, assuming that the crystal possesses zero-point energy of amount half a quantum per degree of freedom, as proposed by Planck.

H. T. Flint and J. W. Fisher: The fundamental equation of wave mechanics and the metrics of space. The wave equation introduced into quantum mechanics by Schrödinger is deduced from a law of metrics in space-time. This law is expressed by a simple divergence equation, which, by making use of Eddington's extension of Weyl's theory, may be converted exactly into the real part of the wave equation. It appears that quantum phenomena are directly related to the gauge factor, λ, of space-time which occupies the place of ψ in Schrödinger's theory.

B. Swirles: The internal conversion of γ-rays. The internal conversion of γ-rays is discussed on the lines of the quantum mechanics. The problem is that of the perturbation of a hydrogen atom of nuclear charge Z by a Hertzian doublet at its centre. An expression is obtained for the coefficient of absorption in the K-levels, which gives values about one-eighth smaller than the experimental ones; the discrepancy is probably due to a neglect of the screening by the other electrons.

A. Muller: On the input limit of an X-ray tube with a circular focus. The well-known heating in the focus of an X-ray tube puts certain limits to the input. An attempt is here made to calculate the limiting input, assuming that the focus spot is a circle.

L. F. Bates: The specific heats of ferromagnetic substances. The thermal and magnetic behaviour of a simple ferromagnetic compound of manganese and arsenic has been studied. This compound has a critical point at 45° C. Heat is very rapidly absorbed when the substance changes from the ferromagnetic to the paramagnetic state. The thermal and magnetic phenomena are intimately connected, and with magnetic change there is associated a heat of transformation. Magnetic phenomena in the region of the critical point are evidence of transformation, which in this case appears to be complete at that temperature, but, in general, may reach only a particular stage at the critical point.

W. Jevons: The ultra-violet band-system of carbon monosulphide and its relation to those of carbon monoxide (the '4th positive' bands) and silicon monoxide. Martin (1913) discovered a band-system in the region λ2837—λ2436 in the carbon disulphide tube discharge and in the sulphur-fed carbon arc. On experimental evidence he ascribed it to CS. More extensive measurements have been made of the heads in Martin's spectrograms and vibrational quantum numbers n', n'' assigned. The two heads of each double-headed band belong to the R and Q branches respectively. The bands are probably of the simplest type, with single R, Q, and P branches. The CS, and also the SiO, systems are attributed to the electronic transition $1^1P \rightarrow 1^1S$, where 1^1S is the normal state and 1^1P the second excited state of the molecule. The CO and SiO systems are more nearly alike than the CO and CS systems as regards (*a*) the ratio of system-origin to comparable atomic line, (*b*) the proportional increase in vibrational frequency, and (*c*) the intensity distribution, and, therefore, the proportional decrease in moment of inertia.

P. E. Shaw and C. S. Jex: Tribo-electricity and friction. (Part 2.) Prepared glass rods are rubbed by various solid elements in an apparatus designed to give constant conditions of pressure and surface. Some elements never, with any type of glass surface tried, show negative charge. These are carbon, cadmium, iron, lead, bismuth, silver, copper, gold, platinum, magnesium, tungsten. Other elements show ultimate negative charge. These are zinc, tin, aluminium, antimony, nickel, cobalt, selenium, telurium, arsenic, chromium, tantalum, and sulphur. Residual acid, alkali, or water films on the glass have a predominating influence on the charging. Rubbing *in vacuo* yields results similar to those found in the open air, at least in the typical cases tried. (Part 3.)

Commercial textile material is unsuitable for precise tribo-electric experiments, on account of natural and artificial impurities. Well-cleansed material acts consistently on the various solid elements. The arrangement of the various elements according to their charges on textiles and glass corresponds closely to their chemical qualities. Anomalies are found in the case of some strongly electro-positive elements, which appear in two places in the tribo-electric series.

G. P. Thomson: Experiments on the diffraction of cathode rays. The patterns formed by cathode rays scattered by thin films of aluminium, gold, celluloid, and an unknown substance are closely similar to those obtained with X-rays in the 'power method.' The sizes of the patterns agree to 5 per cent. with those predicted on the de Broglie theory of wave mechanics, regarding the phenomenon as one of diffraction of the phase waves associated with the electrons.

B. F. J. Schonland: (1) The polarity of thunderstorms. A discussion is given of the tests available for determining the polarity of thunderclouds and further observations at Somerset East are described, which appear to support the conclusions of Craib and the writer that the polarity of these storms was positive. (2) The interchange of electricity between thunderclouds and the earth. Observations were made to examine the part played by (*a*) point-discharge currents, (*b*) lightning discharges between cloud and ground, and (*c*) charged rain, in the electrical interchange between an active thundercloud and the earth. From these observations, (*a*) and (*b*) are estimated to produce continuous currents of the order of 2·1 and 0·1 (equivalent) amperes respectively, in an upward direction, and (*c*) to produce a reverse downward current of the order of 0·02 amp. The resultant current is thus estimated at 2·2 amp. in such a direction as to convey a negative charge to earth.

H. Gregory and S. Marshall: The thermal conductivities of oxygen and nitrogen. The apparatus used was the vertical compensated hot-wire type employed in the determination of the thermal conductivity of carbon dioxide. The results are 589×10^{-7} cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ for oxygen, and 580×10^{-7} cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ for nitrogen, at 0° C. and are consistent with those of Gregory and Archer for the thermal conductivity of air at 0° C.

E. V. Appleton and J. A. Ratcliffe: On a method of determining the state of polarity of downcoming wireless waves. For downcoming waves of 400 metres wave-length in England, the polarisation is approximately circular with a right-handed sense of rotation. According to the magneto-ionic theory of atmospheric deflexion of wireless waves, in which the influence of the earth's magnetic field is taken into account, such right-handed elliptical polarisation might be expected if the effective electrical carriers are of electronic mass.

H. Glauert: The effect of compressibility on the lift of an aerofoil. The effect of compressibility of air on the characteristics of an aerofoil moving with velocity approaching that of sound is of fundamental importance for design of high-speed airscrews. A solution has been obtained of the general equations for the motion of a non-viscous compressible fluid at a large distance from a point-vortex, in a stream of uniform velocity, and an approximate expression has been derived for the effect of compressibility on lift of aerofoil. The analysis appears valid up to a velocity of order 0·6 velocity of sound. In this range, slope of curve of lift coefficient against angle of incidence increases without any change in angle of no-lift.

W. A. Bone, D. M. Newitt, and C. M. Smith: Gaseous combustion at high pressures (Part 9). The effects have been studied of increasing pressure between 1 and 125 atmos. upon the 'explosion limits' of hydrogen–air, methane–air, and carbonic oxide–air mixtures respectively. In the first two, the 'lower' limit remains practically unchanged, but the range of explosibility widens with increasing pressure, particularly for methane-air mixtures. On the other hand, the 'limits of explosibility' of carbon monoxide–air mixtures materially diminish with increasing pressure. The same holds true when nitrogen from air is replaced by argon or helium, but more so when argon is the diluent.

A. T. Doodson: The analysis of tidal observations. The advantages claimed for the new method described are (1) systematic condensation of the observational material; tidal constituents not treated independently of one another until the last stage of analysis; (2) results readily show whether analysis is complete or not; (3) perturbations of one constituent upon another are adequately eliminated; (4) correlation with astronomical arguments is very much simplified.

H. R. Lang: On the measurement of the specific heat of aniline with temperature, using the continuous-flow electric method. Two types of flow calorimeter were used. It was extremely difficult to get the liquid perfectly dry, as it was hygroscopic. The very small water-content was determined in each case from the freezing-point. A separate investigation gave the relation between water-content and freezing-point, a small correction being applied to give the value for perfectly dry aniline. Between 5° and 75° C., rate of change of specific heat with temperature increases with rising temperature.

T. H. Havelock: Wave resistance. Direct proofs are given of certain expressions used in previous calculations. The method can readily be extended to more general cases. The results obtained can be applied to give the wave resistance for any distribution of doublets in any positions and directions in a uniform stream.

K. Yardley: An X-ray study of some simple derivatives of ethane (Part 1). The substances C_2Cl_6, C_2Br_6, $C_2Cl_4Br_2$ (two forms), C_2Br_5F, $C_2Cl_3Br_3$, $C_2Br_4(CH_3)_2$ (two forms), form an isomorphous series, crystallising in the space-group O_h^{16}. The unit-cell contains four plano-symmetrical molecules. Two halogen atoms and the two carbon atoms lie in the symmetry plane (010). The formula of both forms of $C_2Cl_4Br_2$ appears to be $CCl_3 . CClBr_2$. The two CH_3 groups in $C_2Br_4(CH_3)_2$ lie in the symmetry plane. (Part 2.) Attempts to obtain X-ray data for $C_2(CH_3)_6$ and $C_2(CH_3)_5Br$ failed because of the extreme speed with which these substances volatilised. $C_2Br_4(CH_3)_2$ possesses a third (tetragonal) form, which bears no apparent resemblance to the two forms described in Part 1. $C_2(CH_3)_4Br_2$ forms needle-like tetragonal crystals, the molecules themselves simulating tetragonal symmetry. They occupy approximately face-centred positions in a unit-cell of dimensions $10{\cdot}45^2 \times 8{\cdot}14A^3$. The orthorhombic cell of $C_2(CH_3)_5OH$ may be divided into two pseudo-tetragonal parts; in each the arrangement of molecules resembles that in the unit-cell of $C_2(CH_3)_4Br_2$. The space-group is C_{2v}^{21}.

Physical Society, Dec. 9.—H. P. Walmsley: The scattering of light by individual particles in smokes. Applying the expression given by Maxwell for the number of collisions that occur between two sets of spherical uncharged molecules in a gas to the case of a smoke the particles of which cover a wide range of sizes, it appears that particles of a given set collide less frequently with themselves than with those in sets of much larger or much smaller size. If the particles unite on contact, one would expect therefore that the units of the resulting aggregates would differ greatly in size. This result is at variance with the deductions

of Patterson and Whytlaw Gray from experimental data.—**J. J. Manley**: On the construction and standardisation of an interferometer pressure gauge. A Michelson interferometer is applied to the determination of gas pressures ranging from 0·0001 to 20 mm. of mercury. The gauge can be set instantaneously and the pressure which obtained at the moment of setting measured at leisure.—**Anne I. Anderson**: The dielectric constant of liquid bromine. An account is given of a re-determination of the dielectric constant of liquid bromine, the value found being 3·119 at 15° C., and at a frequency of 187,000 per sec., with a temperature coefficient of −0·00191 referred to 0° C. Applying the dipole theory of Debye and Gans to the results, a value of $0{\cdot}40 \times 10^{-18}$ is deduced for the electric moment of the bromine molecule Br_2.

PARIS.

Academy of Sciences, Dec. 27.—Charles Moureu and Charles Dufraisse: Autoxidation and antioxygen action. The theory of antioxygen action, proposed by the authors in previous communications, appears to be opposed to certain consequences of the general theories of catalysis, since, in fact, a certain displacement of equilibrium under the action of a catalyst is implied. The difficulty comes down to the definition of a catalyst, which is critically discussed.—**Pierre Termier**: The Vanoise-Mont Pourri tectonic, in the Savoy Alps, is not separable from the Briançonnais stratum.—**V. Grignard and G. Mingasson**: The mechanism of the catalytic hydrogenation of the phenols. Use is made of the catalytic addition of hydrogen under reduced pressure (with nickel catalyst) to bring out the intermediate phases of the hydrogenation of phenols. The experimental results prove that the addition of hydrogen to phenols follows the course that could be predicted from the Kékulé formula: the two double bonds not adjacent to the hydroxyl group taking up hydrogen giving the enol form of the corresponding cyclohexanone.—**C. Camichel, P. Dupin, and M. Teissié-Solier**: The application of the law of similitude to the periods of formation of the alternate vortices of Bénard-Karman.—**B. Berloty**: Observations of the passage of Mercury across the sun, November 10, 1927, made at the Observatory of Ksara.—**R. Maire and L. Emberger**: General sketch of our phytogeographical knowledge of Morocco: the climatic stages of vegetation.—**Maurice Gevrey**: Conditions at the limits relating to tangential differentials.—**Jules Drach**: Determination of the linear elements of Liouville for which the equation of the geodesic lines admits at least two rational integrals of the first differential.—**Léon Pomey**: Non-linear differential and integral equations.—**Floran Vasilesco**: The problem of Dirichlet.—**W. Gontcharoff**: The determination of functions by the zeros of their differentials.—**Četajev**: The equations of Poincaré.—**Émile Merlin**: The distribution of velocities and densities in a heterogeneous fluid in rotation.—**W. Margoulis**: The application of nomography to the study of turbo-machines with screws.—**Maurice Girault**: The geometrical construction of the profiles of wings by conformal representation of a circle.—**Th. Vautier**: The increase of the intensity and of the duration of extinction of sound.—**Thadée Peczalski**: The dispersion of metals in solid salts under the action of the electric current.—**F. Bedeau and J. de Mare**: Continuous hissing produced by a piezoelectric quartz, emitting simultaneously two high frequency oscillations.—**Ernest Esclangon**: The optical dissymetry of space and the laws of reflection.—**Auguste Le Thomas**: The 'heredity' of castings. The quality of castings from a particular foundry appears to be connected with the foundry and to be independent of the chemical composition. The explanation of this 'structural heredity' is not known.—**Leon Guillet**: Remarks on the preceding communication.—**A. Mailhe and Renaudie**: The transformation of alcohols into petrol. The vapours of normal butyl alcohol passed over uranous oxide heated to 420° C.–440° C. gave a gas containing a high proportion of ethylenic hydrocarbons and a liquid containing butyric aldehyde and a mixture of hydrocarbons boiling between 80° C. and 125° C.—**Paul Combes**: The stratigraphic chronometer of Saint-Nazaire-Penhoët and the age of Glozel. The section exposed by Kerviler in the Penhoët basin in 1877 would place the Neolithic nearer the Christian age than has hitherto been supposed, about seven centuries B.C.—**Joseph Devaux**: The formation of glaciers by the daily fusion and nocturnal regelation of névés. J. Vallot has shown that at the top of Mt. Blanc the snow is transformed progressively into ice, although the temperature remains always below −15° C. The older view of fusion and regelation, however, is not incorrect, and can be shown to be taking place in certain cases.—**H. Colin and Ch. Neyron de Méons**: The inulin of the asphodel.—**Pierre Lesage**: The influence of heat on the potential energy of plants.—**George F. Jaubert**: The destruction of *Galleria mellonella* by means of chloropicrin. The efficacy of chloropicrin in destroying this pest in beehives is proved.—**Gabriel Bertrand**: Remarks on the preceding communication.—**H. Lassalle**: The evaluation of the neuro-muscular excitability. Theoretical discussion.—**Charles Kayser and Albert Ginglinger**: The systematic variations and signification of the respiratory quotient as a function of the temperature in animals.—**H. Simonnet and G. Tanret**: The hypoglycæmic properties of galegine sulphate.—**Jean Saidman**: The biological properties of X-rays of 8 Angström units. X-rays of wavelength 8 A. are absorbed by the superficial layers of the epidermis and do not reach the vascular zone, alterations in which produce dermatitis. The roots of the hair are also unattacked. These rays have been successfully applied to the treatment of chronic eczema of the hands.—**Marcel Duval**: The molecular concentration of the blood of the snail. The influence of the state of activity of the animal. Starting with the known fact that the activity of the snail is markedly affected by the presence or absence of moisture in the air, experiments were devised to see how far the humidity factor regulated the activity by a physico-chemical process. The molecular concentration of the blood was measured during the hibernating state and in summer when moving and when inert within the shell. The expected relation between the activity of *Helix pomata* and the molecular concentration of its blood was proved experimentally.—**Y. Manouélian and J. Viala**: Nerve cells and the virulence of the salivary glands.—**Georges Blanc and J. Caminopetros**: Experimental researches on the antidysentery vaccination in man.—**Burnet**: The impossibility of vaccinating the goat against *M. melitensis* with large doses of vaccine.

Official Publications Received.

BRITISH.

Seventh Congress of the Far Eastern Association of Tropical Medicine: Souvenir. The Indian Empire: being a Brief Description of the Chief Features of India and its Medical and Sanitary Problems. Pp. vii+346 +20 plates+4 maps. (Calcutta.)

Canada. Department of Mines: Geological Survey. Summary Report, 1926, Part A. (No. 2135.) Pp. 60A. Summary Report, 1926, Part C. (No. 2136.) Pp. 143C. Economic Geology Series, No. 4: Arsenic-bearing Deposits in Canada. By M. E. Hurst. (No. 2131.) Pp. iv+181. 30 cents. (Ottawa: F. A. Acland.)

The Gas Light and Coke Company. Printed for the Visit of the Science Masters' Association to Horseferry Road, Fulham and Watson House, Friday, 6th January 1928. Pp. 17+3 plates. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 46: Some Experiments on Feeding Rats with Soya Beans and other Materials. By D. T. Barry and J. Freud. Pp. 513-519. 6*d*. Vol. 18 (N.S.), No. 47: The Formation of Vortices behind a Cylinder moving through a Liquid. By E. T. S. Walton. Pp. 521-534+1 plate. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Africa: Journal of the International Institute of African Languages and Cultures. Edited by Diedrich Westermann. Vol. 1, No. 1, January. Pp. 144. (London: Oxford University Press.) 6*s*.

Union of South Africa: Department of Agriculture. Division of Chemistry Series, No. 85: The Key to the Secrets of Nature—The Indispensable Work of the Chemist. (Being the Annual Report of the Chief, Division of Chemistry, for the Year ended 30th June 1927.) Pp. 10. (Pretoria: Government Printing and Stationery Office.)

Transactions and Proceedings of the New Zealand Institute. Vol. 58, Part 3, September. Pp. iv+189-358+plates 21-37. (Wellington, N.Z.)

Tide Tables for the Eastern Coasts of Canada for the Year 1927: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits; and Information on Currents. Pp. 76. Tide Tables for the Eastern Coasts of Canada for the Year 1928. Pp. 76. (Ottawa: F. A. Acland.)

Tide Tables for the Pacific Coast of Canada for the Year 1927: including Fuca Strait, the Strait of Georgia, and the Northern Coast; with Data for Slack Water in the Navigable Passes and Narrows and Information on Currents. Pp. 72. Tide Tables for the Pacific Coast of Canada for the Year 1928. Pp. 72. (Ottawa: F. A. Acland.)

Annals of the Cape Observatory, Vol. 13. Part 2: Results of Meridian Observations, made at the Royal Observatory, Cape of Good Hope, in the Years 1918-1925, under the Direction of Dr. H. Spencer Jones. Pp. xvii+114. (London: H.M. Stationery Office.) 17*s*. 6*d*. net.

Cape Astrographic Zones, Vol. 11. Catalogue of Rectangular Co-ordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope. Commenced under the Direction of Sir David Gill; Completed and prepared for press under the Supervision of S. S. Hough. Zone −51°. Pp. xxxvi+466. (London: H.M. Stationery Office.) 55*s*. net.

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 8, Memoir No. 4: The Fossil Suidæ of India. By Dr. Guy E. Pilgrim. Pp. vi+104+20 plates. (Calcutta: Government of India Central Publication Branch.) 11.12 rupees; 19*s*.

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 7, Technological Series No. 3: Technological Reports on Standard Indian Cottons, 1923-26. By A. James Turner. Pp. iii+95. Bulletin No. 9, Technological Series No. 4: The Effect of Temperature and Humidity on Cotton Spinning, with particular reference to Conditions in Bombay. By A. James Turner. Pp. ii+46. 2 rupees. Bulletin No. 10, Technological Series No. 5: The Effect of subjecting Cotton to repeated Blow-Room Treatment. By A. James Turner. Pp. ii+23. 1 rupee. Bulletin No. 11, Technological Series No. 6: Technological Reports on Standard Indian Cottons, 1927. By A. James Turner. Pp. vi+117. 2 rupees. (Bombay.)

FOREIGN.

United States Department of Agriculture. Technical Bulletin No. 19: Parasites of the Pink Bollworm in Hawaii. By H. F. Willard. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents.

University of Washington Publications in Anthropology. Vol. 2, No. 1: Adze, Canoe and House Types of the Northwest Coast. By Ronald L. Olson. Pp. 38. Vol. 2, No. 2: The Ghost Dance of 1870 among the Klamath of Oregon. By Leslie Spier. Pp. 39-55. (Seattle, Wash.: University of Washington Press.)

Lauksaimniecības pārvaldes rakstu krājums. VI burtnica. Latvijas jūras zvejniecība 1926 gadā. Sakopojis V. Miezis. (Bulletin statistique des Pêches maritimes de Lettonie, année 1926. Rédigé par V. Miezis.) Pp. 49. (Riga.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 79. Notes on the Philippine Fishes in the Collection of the Academy. By Henry W. Fowler. Pp. 255-297. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 80, No. 5: Drawings by A. DeBatz in Louisiana, 1732-1735. By David I. Bushnell, Jr. (Publication 2925.) Pp. 14+6 plates. (Washington, D.C.: Smithsonian Institution.)

Journal de la Société des Américanistes de Paris. Nouvelle Série, Tome 19. Pp. xxix+559. (Paris.)

U.S. Department of Agriculture: Weather Bureau. Monthly Western Review, Supplement No. 29: The Floods of 1927 in the Mississippi Basin. By H. C. Frankenfield. (W.B. No. 936.) Pp. 49+7 plates. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 92-94: Syntheses of some Fatty-Aromatic Amines containing Phenolic Hydroxyl Groups in Benzene Nucleus, by Shôzô Kobayashi; Relation between Chemical Constitution and Pungency in Acid Amines, by Shôzô Kobayashi; Double Compounds of α-Unsaturated Acid Amines with Acid and with Ammonia, by Shôzô Kobayashi. Pp. 149-196. 53 sen. No. 111: The Radiograph of a Crystal having the Face-centered Cubic Lattice. By Masaichi Majima and Sakuichi Togino. Pp. 75-78+plates 5-19. 40 sen. No. 116: On the Reproductive Failure of White Rats on Synthetic Diets. By U. Suzuki, W. Nakagara and N. Hashimoto. Pp. 143-152+4 charts+plates 20-22. 55 sen. Nos. 117-118: Über die Löslichkeit der Cellulosesester, 1 Mitteilung, von I. Sakurada and T. Nakashima; Über die Löslichkeit der Cellulosesester, 2 Mitteilung, von I. Sakurada and T. Nakashima. Pp. 153-172. 30 sen. Nos. 120-121: The Effect of Caustic Alkali on the Oxidation of Stannous Chloride by Air, by Susumu Miyamoto; On the Oxidation of the Mixture of Stannous Chloride and Sodium Sulphite in Alkaline Solution by Air, by Susumu Miyamoto. Pp. 189-200. 25 sen. No. 122: Residual Thermoelectric Phenomena of apparently Homogeneous Wire. By Torahiko Terada, Toshimasa Tsutsui and Mituo Tamano. Pp. 201-236. 60 sen. (Tokyo: Iwanami Shoten.)

Annales de l'Observatoire d'Astronomie physique de Paris. Tome 7: Recherches sur la constitution des comètes et sur les spectres du carbone. Par F. Baldet. Pp. iv+109+5 planches. (Paris.)

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102. Mededeelingen en Verhandelingen, 1a: Het Koninklijk Nederlandsch Meteorologisch Instituut. A: Organisatie en Inrichting. (Institut Météorologique Royal des Pays-Bas. A: Organisation et Disposition.) Pp. 72+9 planches. ('s-Gravenhage: Algemeene Landsdrukkerij.) 1.00 f.

Annotationes Zoologicæ Japonenses. Vol. 11, No. 2, July 25. Pp. 97-194+6 plates. Vol. 11, No. 3, November 8. Pp. 195-267+10+9 plates. (Tokyo: Zoological Society of Japan.)

Instituto Geográfico y Catastral. Anuario del Observatorio Astronómico de Madrid para 1928. Pp. 541+lvi. (Madrid.)

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des Pêches maritimes des Pays du Nord et de l'Ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 15, pour l'année 1925. Pp. 49. Journal du Conseil. Rédigé par E. S. Russell. Vol. 2, No. 3. Pp. 267-400. (Copenhague: Andr. Fred. Høst et fils.)

Reprint and Circular Series of the National Research Council. No. 80: Doctorates conferred in the Sciences by American Universities, 1926-1927. Compiled by Callie Hull and Clarence J. West. Pp. 36. (Washington, D.C.: National Academy of Sciences.) 50 cents.

Bulletin of the American Museum of Natural History. Vol. 57, Art. 4: The Chilopoda and Diplopoda collected by the American Museum of Natural History Congo Expedition (1909-1915), with Notes on some other African Species. By Ralph V. Chamberlin. Pp. 177-249. (New York City.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 27: Measurement of Variable Velocity relative to Air with Pitotstatic Tube. By Koroku Wada and Syôdirô Nisikawa. Pp. 327-396. (Tôkyô: Kôseikai Publishing Office.) 1.05 yen.

U.S. Department of the Interior. Report of the Commissioner of Education for the Year ended June 30, 1927. Pp. iii+32. (Washington, D.C.: Government Printing Office.) 10 cents.

CATALOGUES.

A Catalogue of General Literature, including History and Biography. (No. 440.) Pp. 20. (Cambridge: Bowes and Bowes.)

B.L.M. Microscopes. Pp. 12. (London: Charles Baker.)

Diary of Societies.

SATURDAY, FEBRUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660-1759) (I.).

ASSOCIATION OF WOMEN SCIENCE TEACHERS (Annual General Meeting) (at St. Paul's Girls' School), at 4.30.—Sir John Russell: The Growth of Crops: Applications of Botany and Chemistry to Country Life (Lecture).

RURAL CONSTRUCTION ASSOCIATION (at London School of Economics), at 5.50.—R. Borlase Matthews: Electricity in Rural Life.

WESTERN JUNIOR GAS ASSOCIATION.—Thomas Hardie: Address.—Dr. E. W. Smith: Modern Tendencies in Carbonising Practice.

MONDAY, FEBRUARY 6.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. F. O. Bower: Obituary Notice of A. Anstruther Lawson.—Prof. W. H. Lang: The Flora of the Old Red Sandstone of Scotland: a General Survey.—E. B. Bailey: Schist Geology: Braemar, Glen Clunny, and Glen Shee.—Dr. H. H. Read: Highland Schists of Middle Deeside.—*To be read by title only:* —Prof. D. M. Y. Sommerville: An Analysis of Preferential Voting.—Sir Thomas Muir: The Theory of Jacobians from 1885 to 1919.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Rev. A. H. Finn: The Miraculous in Holy Scripture.

BIOCHEMICAL SOCIETY (at Lister Institute), at 5.—H. Jephcott and A. L. Bacharach: The Quantitative Estimation of Vitamin D.—A. L. Bacharach and E. Allchorne: The Vitamin B Content of Malt Extract.—M. G. White and J. J. Willaman: The Alcoholic Fermentation of Pentoses by Fusarium Lini.—Prof. A. V. Hill: Increased Anaerobic Metabolism in Muscle following Stimulation.—D. Jordan Lloyd and W. B. Pleass: The Effect of Nitrates on the Absorption of Water by Gelatin.—H. W. Kinnersley, R. A. Peters, and V. Reader: Metabolic Constancy in the Pigeon.—R. T. Brain and H. D. Kay: Phosphate Excretion.—R. P. Cook and B. Woolf: The Deamination and Synthesis of l-aspartic Acid by Bacteria.—R. Robison and K. M. Soames: Calcification in Vitro.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Percy Sargent: The Surgery of the Posterior Cranial Fossa.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—C. H. J. Clayton: The National Rivers and their Functions (Presidential Address).—D. C. Fidler: Presentation of Premiums awarded in 1927.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—W. West: Foundry Work.—C. T. Skipper: Machining Operations on a Six-Cylinder Block.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. Selley and others: Discussion on Domestic Water Heating.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—F. H. Carr: Some Problems Encountered in Making Fine Chemicals.

SURVEYORS' INSTITUTION (at Institution of Civil Engineers), at 8.—L. Crouch: The Landlord and Tenant Act, 1927.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—T. A. Barns: In Portuguese West Africa.

TUESDAY, FEBRUARY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. P. Newton: The Settlement of the Dominions, 1783-1870.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of October, November, December 1927, and January 1928.—D. Seth Smith: Exhibition of a Blue Variety of the Masked Love-bird (*Agapornis personata*).—Dr. P. R. Lowe: Studies and Observations bearing on the Phylogeny of the Ostrich and its Allies.—S. Zuckerman: The Age-changes in the Chimpanzee, with Special Reference to Growth of Brain, Eruption of Teeth, and Estimate of Age, with a Note on the Taungs Ape.—F. F. Laidlaw and the late H. Campion: Notes on Oriental Dragonflies (Odonata) with Descriptions of New Species.

INSTITUTION OF CIVIL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Annual Spring Exhibition.—Miss C. E. Longfield: By Rail, Road, and River, through the Heart of South America.—Rev. H. J. Gamble: My Week-end in the Home of Tutankhamen (Lectures).

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—C. D. Gibb: Modern Reaction Turbines.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—F. H. Clough; Stability of Large Power Systems.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—Prof. F. C. Lea: Testing of Metals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—A. Keighley: North Palestine and Syria.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. J. A. Smythe and C. E. Pearson: Demonstration of Mechanical Testing of Metals.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.

ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 7.45.—Wing Cmdr. J. G. V. Fowler: The Repair and Maintenance of Aero Engines.

WEDNESDAY, FEBRUARY 8.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. Grey Turner: The Treatment of Congenital Defects of the Bladder and Urethra by Implantation of the Ureters into the Bowel, with a Record of 14 Personal Cases.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. W. J. Pugh: The Geology of the District around Dinas Mawddwy (Merioneth).

ROYAL SOCIETY OF MEDICINE (Sub-Section of Proctology), at 5.30.—F. J. McCann: An Operation for Prolapse of the Rectum in the Female.—Z. Cope: The Treatment of Irreducible Sigmoido-rectal Intussusception in Old People.—W. B. Gabriel: Four Cases of Small Gut Obstruction Round Colostomies.—Demonstration by Dr. P. H. Manson-Bahr: Sigmoidoscopic Appearances in Colitis.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at Royal Anthropological Institute), at 6.—Dr. M. Culpin and others: Discussion on Occupational Neuroses.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—N. Alan: Gases in Metals, with Special Reference to Copper.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Graduate Section) (Middlesbrough), at 7.30.—E. Graham: Some Notes on Ship Construction.

ROYAL SOCIETY OF ARTS, at 8.—H. D. Wilkinson: Theatre Lighting.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—Prof. O. W. Richardson: On the Extraction of Electrons from Cold Conductors in Intense Electric Fields.—R. H. Fowler: (*a*) The Restored Electron Theory of Metals and Thermionic Formulæ; (*b*) The Photo-electric Threshold Frequency and the Thermionic Work Function.—P. A. M. Dirac: The Quantum Theory of the Electron.—Dr. H. T. Flint and Prof. O. W. Richardson: On a Minimum Proper Time and its Application to (1) the Number of the Chemical Elements, (2) Some Uncertain Relations.—*To be read in title only*:—Dr. H. Jeffreys: Some Cases of Instability of Fluids.—Dr. H. T. Flint: Relativity and the Quantum Theory.—C. A. Clemmow: A Theory of Internal Ballistics based on a Pressure Index Law of Burning for Propellants.—Prof. H. A. Wilson: The Emission of Light by Flames containing Sodium and the Absorption of Light by Mercury Vapour.—C. N. Hinshelwood and H. W. Thompson: The Kinetics of the Combination of Hydrogen and Oxygen.—E. T. Copson: On Electrostatics in a Gravitational Field.—K. Darwin: Examples of the Zeeman Effect at Intermediate Strengths of Magnetic Field.—W. R. Brode: The Analysis of the Absorption Spectrum of Cobalt Chloride in concentrated Hydrochloric Acid.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: From Faraday's Note Books (2). "Crispations": The Forms of Fluids on Vibrating Surfaces.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Colour Group), at 7.—T. J. Offer: Instantaneous Colour Photography in the Theatre.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Nottingham University College), at 7.30.—A. J. Hall: Action of Alkalines on Cotton and Art Silk.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—J. Conway: Development of the Rotary Converter.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—R. G. Batson: Properties of Metals and Alloys at High Temperatures.

OPTICAL SOCIETY (at Imperial College of Science and Technology) (Annual General Meeting), at 7.30.

ROYAL SOCIETY OF MEDICINE (Ophthalmology and Neurology Sections), at 8.30.—Dr. J. Collier (Neurology), F. A. Williamson-Noble (Ophthalmology), Dr. A. Feiling, Dr. J. R. Perdrau, M. L. Hine, R. Foster Moore, and Dr. W. J. Adie: Special Discussion on Ocular Complications of Encephalitis Lethargica.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, FEBRUARY 10.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Sir Edward A. Gait: Bihar and Orissa (Sir George Birdwood Memorial Lecture).

ROYAL ASTRONOMICAL SOCIETY (Anniversary Meeting), at 5.—Presidential Address; Presentation of the Gold Medal to Prof. R. A. Sampson, and of the Jackson-Gwilt Medal to Dr. Steavenson.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at 11 Chandos Street, W.), at 5.—Dr. A. A. Mumford: The School Medical Officer of the Future.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. A. Ferguson and E. J. Irons: A Simple Graphical Method for the Determination of Galvanometer and Fluxmeter Constants, with a Note on the Measurement of Intense Magnetic Fields.—Dr. C. J. Smith: On a Method of Constructing the Caustic Curve formed by Refraction at Plane Surfaces.—J. C. Hudson: The Application of Electrical Resistance Measurements to the Study of Atmospheric Corrosion of Metals.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. H. Sheldon: An Undescribed Disease of Bone.

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

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 6.—J. E. Southcombe: Some Contributions to the Theory and Practice of Lubrication.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Manchester Association of Engineers) (at Engineers' Club, Manchester), at 7.15.—E. J. Parish: Inspection Methods.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Prof. H. P. Philpot: Some Principles of Investigation in Engineering Work.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—J. B. Forster: Casting.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Society of Dyers and Colourists) (at Chemical Society), at 8.—E. A. Alliott: Dry Cleaning and Finishing Machinery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. B. Melvill Jones: Research on the Control of Aeroplanes.

SOCIETY OF DYERS AND COLOURISTS (Scottish Section) (at Glasgow).—Dr. H. H. Hodgson: The Relation between Laboratory and Bulk Production.

SATURDAY, FEBRUARY 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660–1759) (2).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 4.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Mrs. R. Aitken: Village Life in High Castile.

MONDAY, FEBRUARY 6.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Dr. H. P. Biggar: The Discovery of Canada from Cabot to Champlain.

GRESHAM COLLEGE, at 6.—G. P. Bailey: Modern Science and Daily Life: Rare Gases of the Atmosphere.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—W. R. Day: The Cultivation of the Cricket Bat Willow.

TUESDAY, FEBRUARY 7.

KING'S COLLEGE, at 5.30.—Prof. S. Alexander: Emergence, or Primary, Secondary and Tertiary Qualities of Things. (Succeeding Lectures on Feb. 14 and 21.)

UNIVERSITY COLLEGE, at 8.15.—Miss E. Jeffries Davis: More London Place-Names. (Succeeding Lectures on Feb. 14, 21, 28, and Mar. 6.)

WEDNESDAY, FEBRUARY 8.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30.—Dr. W. Norwood East: Some Problems of Forensic Psychiatry.

UNIVERSITY COLLEGE, at 5.30.—I. C. Gröndahl: Norwegian Country Life, Customs and Sayings. (Succeeding Lectures on Feb. 15 and 22.)

THURSDAY, FEBRUARY 9.

UNIVERSITY COLLEGE, at 5.30.—Prof. P. Fleming: Relics of Monastic London.

FRIDAY, FEBRUARY 10.

GUY'S HOSPITAL MEDICAL SCHOOL, at 5.30.—G. Simpson: The Surgery of the Kidney and Ureter. (Succeeding Lectures on Feb. 17 and 24.)

UNIVERSITY COLLEGE, at 5.30—E. J. Holmyard: Chemistry in Mediæval Islam.

SATURDAY, FEBRUARY 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: In the Haunts of the Sea-birds.

CONFERENCE.

TUESDAY, FEBRUARY 7.

CONFERENCE ON POWER FOR CULTIVATION AND HAULAGE ON THE FARM (at Rothamsted Experimental Station), at 11.30 A.M.—Chairman: Sir Merrik Burrell.

H. C. Burford: The Design of a General Purpose Tractor.
G. W. Watson: The Care of the Tractor on the Farm.
E. Porter: Practical Experience of Power on the Farm.
R. D. Mozer: Rotary Cultivation.
Dr. B. A. Keen: Horse and Mechanical Power in Farm Operations.