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Reform of the British Patent System.<sup>1</sup>

THE recent publication of the Report of the Committee which was appointed by the British Science Guild in April of last year to consider what changes could advantageously be made in the patent law of Great Britain, will of necessity rivet the attention of all those who appreciate the very important part which a sound system of monopoly grants in respect of new inventions can achieve in encouraging progress in industrial development. The days are long past when the desirability of granting patents for inventions was regarded as a debatable matter, and the abolition of patents was advocated by quite responsible schools of opinion as being one step in the direction of freeing trade and industry from all those trammels and obstacles that hinder full development. More and more we have come to recognise that the well-being of a modern industrialised State depends on the continuous and intensive concentration of the most original and creative minds upon the task of increasing the efficiency of human labour, that is to say, in enabling more wealth to be produced or more services to be rendered by a given expenditure of human effort.

Progress in the application to useful ends of the rapidly growing knowledge furnished by science, and progress in that widely different sphere of inventive art which leads to the construction of automatic or semi-automatic labour-saving machinery—these are vitally essential if the growing populations of great industrial States are to enjoy even a reasonable minimum of welfare and contentment. Inventions such as the telephone or the manufacture of artificial silk on one hand, and inventions such as linotype and monotype machines, or boot and shoe making machinery on the other, typify the manner in which a relatively small proportion of origination or creative minds can add, generation by generation, to the effective capital of human knowledge, and thus provide the equivalent as regards all the needs of life except perhaps the primary need of foodstuffs, of the proverbial means whereby two blades of grass are made to grow where one only grew before; and even the fundamental industries of agriculture, stock-raising, and dairy farming owe much to purely scientific experiment and research and to the inventors of the more complicated forms of mechanical aids to labour.

With a growing perception of the necessity for

<sup>1</sup> "Report of the Committee appointed by the British Science Guild to consider the Reform of the British Patent System." Pp. 48. (London: British Science Guild, 1928.) 2s.



encouraging and utilising to the full such inventive capacity as is available in any given generation, we have come to realise that under modern conditions it is more than ever difficult to give the inventor his full opportunity, unless really effective protection by way of monopoly is accorded to new inventions for a term of years. Such protection is necessary for two reasons. First, there is in every industry severe competition, and every manufacturer must be watchful of improvements or he will not keep abreast of the times; knowledge of new methods diffuses rapidly through the technical press: and modern methods of transport have overcome the barrier offered by distance. There is no question, therefore, of even a temporary monopoly accruing to the originator of some new machinery or some new process in the absence of any legal monopoly rights. Secondly, capital plays a larger and larger part in the development of industry. Even minor though useful inventions frequently demand a capital expenditure far beyond the range of an individual inventor before they can be put effectively upon the market; and if capital is to be attracted to a new and unproven enterprise, some security must be afforded that when the experimental period is over, and the new article is upon the market, or the new process is in operation on a commercial scale, watchful competitors will not at once step in and reap, or at least share the reaping, where they have not sown.

There is perhaps a tendency in these days to give disproportionate public recognition to the inventions that originate in scientific work as opposed to those that owe little to the growth of scientific research. The public is continually being asked to admire some new miracle of science. Such inventions as photography, the telephone, the transmission of power by electricity, radio telegraphy and telephony, synthetic chemistry, X-rays, cinematography, television, and so forth, strike the public imagination as being marvellous achievements arising directly out of scientific researches of which they can understand but little. Improvements in textile machinery, boot and shoe-making machinery, wood-working machinery, refrigerating plant, bread-making machinery, and automatic machine tools are less calculated to strike the public imagination, but they play at least as large a part in solving the problem of maintaining or improving the standards of life of large and still growing populations. Inventions of this latter kind are not without their debts to science, but they largely arise by the creative energy of minds not mainly trained and developed in the laboratory. There is an

originative type of mechanical mind that owes little to scientific knowledge.

Both of these types of creative invention, however, depend largely on a sound system of patent law if they are to be encouraged and developed and are to have their full effect on the general public welfare. Patent law and patent jurisprudence are therefore subjects deserving of serious study by any government, and should be revised and modified from time to time so as to preserve their full efficiency as instruments of progress.

The law in relation to patents should be so framed and so administered that, on one hand, it furnishes to the inventor and to his coadjutor the capitalist a secure protection for such new manufacture or improvement in old manufacture as has in fact been made. On the other hand, the law should be such, and its administration should be such, that if the inventor makes unduly broad claims, such as would either encroach upon existing rights or liberties, or would extend too far beyond the ground actually explored and brought under cultivation, as it were, by the inventor, such unduly broad claims can be refused, or at least made the subject of an official warning to the public.

There is always a danger that patents, if granted too freely without careful consideration of the existing state of the art, may hamper those who ask no more than to use existing knowledge intelligently in the ordinary variations of manufacture. There is also the danger that an astute draftsman of the claims in a patent specification may endeavour to claim in advance, developments not unlikely to flow from the invention, but as yet unexplored and unknown. He may stake out, as it were, a whole county instead of pegging out the claim upon which the inventor, as prospector, has established some sort of equitable title. Very real evils, particularly in the chemical industry, arise out of this last-named tendency, which has been fostered by a change in the law made in 1919 whereby a patentee can succeed in his first action for infringement despite the presence in his specification of one or more unwarrantably broad claims.

Broadly speaking, it may be said that the patent law of Great Britain is soundly framed, and that its administration both by the Comptroller-General and in the Courts is carried out efficiently and with balanced and equitable judgment in reconciling the interests of the inventor and of the public. But in very many directions, both of detail and of major import, there is undoubtedly room for reform, both legislative and administrative. In recent years,



demands for such reform have been increasingly manifest.

Paradoxical as it may seem, the greatest single reform that could be carried out would probably be the provision of some means whereby patent litigation could be encouraged by rendering it inexpensive. It is not far from the truth to say that the validity of no patent is certain until it has actually been tested in the Courts. It is also true to say that industry would be greatly benefited if there were some more expeditious and inexpensive way of determining if a particular mode of manufacture is or is not an infringement of a patent which is alleged to include such manufacture within its claims.

There is at present far too much uncertainty in relation both to the validity and to the scope of patents. Each patent is in the nature of a prohibition or warning to avoid certain modes of manufacture, and the number of patents actually in force at any one time in each industry varies from hundreds up to many thousands. One can easily picture the confusion that would exist in relation to real property if the boundaries of thousands of important estates were indefinite and the titles themselves uncertain, and it were known that neither could be determined except by a very expensive process of law. This is practically the position in relation to patents. The technical issues are frequently complicated and difficult, and the costs of a judicial settlement are great. The determination of the issue of validity or infringement, or more frequently of both, is a luxury that few can afford. If the patentee has the smaller purse, he may be helpless against the infringer; if the patent is in very strong financial hands, it may be made the basis of excessive or even wholly unwarranted demands. But although no other reforms can be fully effective while this difficulty remains unresolved, it presents a problem to which no solution can readily be found. The Report of the British Science Guild touches upon it only partially and tentatively.

Reform of the patent law being admittedly called for, the British Science Guild deserves thanks for its initiative in appointing a strong and representative committee to consider this matter and to report thereon. The Committee, under the distinguished chairmanship of Dr. W. H. Eccles, has presented a Report which it may be safely said will furnish invaluable aid to those whose duty it may be to draft any future Patents Bill for consideration by Parliament. The Report covers a great deal of ground, and it is impossible to furnish here anything in the nature of a compendium of its contents.

Many of the recommendations made in the Report are uncontroversial and arise out of the experience of the nine years since the passing of the Patents Act of 1919. It may indeed be assumed that but for the serious and growing difficulty arising out of the shortage of available Parliamentary time, many of the anomalies, deficiencies, and defects which have been disclosed by experience would already have been remedied by the passing of an amending Act when opportunity presented itself. Until Parliament is prepared to delegate more of its work to standing or select committees, it is difficult to see how, under present-day conditions, the Statute Book is to receive necessary emendation in all the many ways in which such changes are called for. Perhaps patent law is in no worse case than many other branches of the law in that respect.

Apart, however, from these minor recommendations, which, taken collectively, are of no inconsiderable value, the Committee has dealt with a number of more important issues, and it may be useful to direct special attention to certain recommendations which deserve full consideration and discussion.

The Committee recommends that the search made in the Patent Office as regards novelty should no longer be restricted to British specifications, but should be extended to other relevant documents. At the present time the statutory search is limited to the last fifty years of British specifications. The examiner sometimes cites informally some publications outside this restricted field that are within his knowledge, but it is for the inventor to say whether he will act upon such communicated information or not. There is a certain anomaly in the fact that although the official search is so restricted, an opponent to the grant of the patent may bring forward any documentary publication whatever that has been made in Great Britain, including of course the published specifications of other countries.

In opposition proceedings the Comptroller may thus amend the claims or even refuse the grant of a patent, on the basis of documents which the examiner could not formally cite even if they were within his knowledge. The Committee recognises that an extension of the search to cover the scientific and technical literature of the world and the patent specifications of foreign countries involves an immense task, that could perhaps never be fulfilled in its entirety; but it advises that such an extension of the field of search should be introduced gradually, and it also points out that the large balance of receipts from patent fees over expenditure, which is at present used for the general purposes of the national exchequer, would cover the



cost of a very large extension of the official area of search. The advantage of such an extension would be that it would increase the security and so improve the status of British patents, and thus be conducive to the financial support which is so necessary to an invention in its early stages.

The Committee makes a recommendation which will be of interest to research workers in fields of science which are systematically explored by known methods of research. It states that there is a fear in the minds of some research workers that the validity of patents for research inventions may be imperilled by the circumstances of their origin. The Committee sees no necessity in this case for statutory enactment, but expresses the opinion that the Courts, in deciding upon the presence of subject matter for a patent in any particular instance, ought to give very favourable consideration to an alleged invention which has arisen from prolonged and meritorious research work even on a laboratory scale.

On the vexed question of granting monopoly rights in respect of discoveries which at the time they are made are not seen to be clearly capable of industrial use, the Committee makes no recommendation. The matter is one that has recently engaged the attention of the League of Nations, but it is admittedly a most difficult problem to deal with in any practical fashion.

On the question of biological inventions, the Committee thinks that something could be done to permit the patenting of a wider range of such inventions than is now possible, excluding, however, inventions subserving medical treatment. As regards these last-named inventions, the Committee is impressed by the strong adverse view of the medical profession. On the broader question, the difficulties are set forth with great clarity in a letter from Sir Daniel Hall which is printed as one of the appendices to the Report. Sir Daniel Hall, while wishing the British Science Guild success in its exploration of this question, confesses that he has never seen a method on which it might reasonably be hoped to secure legislative action.

The Committee is of opinion that the Comptroller should be entitled to call, where in doubt, for *prima facie* evidence that the invention has been described in a practicable form in the specification, and to endorse the specification with a warning notice where his objection is not satisfied. It recognises that in many cases such a course would scarcely be fair to the inventor, but the procedure could be used with devastating effect when dealing with the inventors of perpetual motors and of like impracticable schemes, and in cases where a dishonest

specification is filed in which knowledge essential to successful working is withheld.

The Report does not, however, endorse a suggestion that four years after applying for his patent a patentee should be given an opportunity of revising his description, and that after an official inspection of his process the Comptroller should, if satisfied, give a certificate of sufficiency of description. This proposal was put forward to meet the difficulty that in the commercial working of an invention details are frequently found to be important which are not recognised as such at the time of filing of the original specification, and it is in the public interest as well as in that of the inventor that the specification of a proved and successful invention be made as full and perfect as possible in all its details. The matter is perhaps one that deserves further consideration.

'Short term patents' form the subject of an interesting section of the Report. It is recommended that a type of patent corresponding in part to the German *Gebrauchsmuster* or utility design be introduced into the British system. Such patents would be granted, for a period not exceeding seven years, for new and useful variations of known constructional forms and arrangements, and possibly also for compositions characterised by the inclusion of new ingredients. The scope of such patents should be narrow and rigorously defined, and the scale of fees should be low.

The heavy expense attaching to patent actions in the High Court, to which reference has been made above, has led the Committee to recommend legislation whereby the Comptroller should be empowered to act as a Court, subject to a definite limit of damages and to the consent of the parties, for deciding questions relating to the infringement of patent rights and for deciding at any time upon petitions and counter claims for the revocation of patents on all the usual grounds of invalidity. The parties should in each case agree beforehand as to whether the Comptroller's decision is to be final or subject to appeal. The Committee also recommends that appeals from the Comptroller's decisions should in all cases be heard by a special judge in chambers, instead of by the Law Officers of the Crown, to whom the large majority of appeals are at present referred under statute.

The Report closes with a recommendation that failing the institution of an Empire patent, in connexion with which the difficulties have so far proved insuperable, there should be provision for the grant of a restricted British Empire patent which should run throughout the Crown Colonies



and Protectorates. Should India or any of the self-governing Dominions be willing to become parties to the scheme, their adhesion should be welcomed.

We have said enough in this incomplete summary to show that the Report is a document well deserving of close study by all who are interested in the reform of British patent law. It may be hoped that the British Science Guild and the Committee will reap the reward that would be most welcome to them, namely, the knowledge that their labours have contributed in some degree at least to the advancement of industry and to the equitable reward of those engaged in scientific research.

### The Last Ice Age.

*The Last Glaciation: with Special Reference to the Ice Retreat in North-eastern North America.* By Ernst Antevs. (American Geographical Society Research Series, No. 17.) (Shaler Memorial Series.) Pp. x+292+9 plates. (New York: American Geographical Society, 1928.) 3.50 dollars.

THE past decade has seen a great revival of interest in the whole subject of climatic changes. There have been many books presenting as many theories, so diverse as to be mutually destructive. At the same time, a great amount of new knowledge has been gained both by exploration in distant corners of the earth and by the application of exact methods of investigation to the classic centres in Europe and North America. It was evidently time to pause for an impartial consideration of the fundamental facts of the problem, and, so far as the Quaternary glaciation is concerned, we can have no better guidance than that of Dr. Ernst Antevs, with his close knowledge of the work of De Geer in Sweden and his subsequent experience in the other great centre of glaciation in North America. These fundamental problems, which must be definitely solved before we can profitably indulge in more elaborate speculations, are twofold. First, was the Quaternary Ice Age synchronous in different parts of the world? Secondly, what were the peculiar climatic conditions which caused the great accumulation of snow and ice? Both of them are closely involved with the interpretation of the peculiar banded fluvio-glacial clays known as varves.

The question of synchronism has long been obscured by the controversy as to whether the Quaternary Ice Age was a single episode or was divided into a number of alternating glacial and interglacial periods. That controversy now ap-

pears to have been decided, for few would disagree with Antevs' verdict that advancing knowledge has brought "a growing conviction that everywhere the glaciation was multiple, consisting of three or four successive epochs." In North America it has long been held that these successive epochs were not equally developed in all parts of the continent, but that the centre of glaciation migrated from west to east. Antevs believes, however, that this migration was a minor feature, and that the various stages were essentially synchronous in different parts of the continent. The same dictum applies to Europe; the correlation of deposits in Europe and North America is more difficult, but all the available evidence points to synchronism. The general similarity and parallelism in Asia also "convincingly show that the glacial and interglacial epochs were essentially synchronous in all the northern hemisphere." In the southern hemisphere the glaciations of South America and Australia appear to correspond in the same way, but it is not yet possible to say that the glaciations coincided in the two hemispheres. Recent comparative studies of annual layers of banded clays appear to show that they did coincide, but Antevs is fully alive to the dangers of long distance correlation on such evidence alone. Thus while a migrating pole is definitely ruled out, astronomical causes still remain possible.

The lowering of sea-level caused by the locking up of water in the form of ice is important in this connexion, but does not lead to a perfectly definite answer. Antevs' calculation of the ice volume at maximum glaciation shows that the accumulation in the northern hemisphere was sufficient to lower sea-level by about 272 feet. The ice in the southern hemisphere in excess of that now present adds about 33 feet. Hence, if the maximum glaciation had been exactly synchronous in all areas, the lowering of sea-level should have been about 305 feet. Actually it was at least 250 feet—additional evidence for synchronism in the northern hemisphere, but not necessarily between north and south.

The discussion of the chronological results obtained from the study of varve clays is cautious, but the correlation of the slow retreat of the ice-border across southern Ontario with the prolonged oscillations in the Danish islands and southern Scania is regarded as almost certain. This phase ended about 14,000 B.C.; from a consideration of all the evidence, Antevs decides that the last ice sheets had their greatest extent and began to wane between 50,000 and 30,000 years ago.

The comparative study of various centres of



glaciation points strongly to low summer temperature as the dominant factor in glaciation, though increased snowfall was locally important, especially in the tropics. This verdict of Antevs' suggests a general increase of cloudiness as the immediate cause of the ice age; it is for meteorologists to say what caused the increase of cloudiness.

The book closes with a detailed account of the author's studies of varve clays in North America. This part is for the specialist only, while the first half of the book is of very general interest. The first half is not nearly long enough, and one could have wished that the author had devoted the whole of this book to a fuller discussion of the general problems, and treated the special varve studies in a separate volume.

C. E. P. BROOKS.

### Scientific Humanism.

*The Scientific Habit of Thought: an Informal Discussion of the Source and Character of Dependable Knowledge.* By Prof. Frederick Barry. Pp. xiii + 358. (New York: Columbia University Press; London: Oxford University Press, 1927.) 17s. 6d. net.

PROF. BARRY, of the Columbia University, has written an important and timely book on a question, or series of questions, which must often occupy the minds of readers of this review. How is it that the colossal progress of science, and the way in which science now permeates and dominates every department of practical life, is so little appreciated by the mass, even of the thinking public, which is thus dominated? Anyone can see—and this perception prompted Prof. Barry's essay—that there is a great gulf fixed between the practitioners of science and that small minority who more or less understand its methods, and the great public who enjoy its inventions and bow the head in distant reverence at its power, but have no conception either of the nature of a scientific discovery or how such discoveries are utilised for the improvement of life. Here, then, is a magnificent subject and a very urgent one—to build a few bridges over this gulf.

Prof. Barry's work is well and usefully done in a book of four chapters, and everyone, expert or layman, would be the wiser for following the author's footsteps. But a word of warning, though not of discouragement, is called for. It is not an easy book. A conscientious reviewer, who makes a practice of reading through his books, sat down to get through it comfortably after dinner. He found it demanded several sittings and a running analysis.

It might, indeed, have been improved for its wholly admirable purpose if the author had broken it up more himself, used more illustrative instances, and a simpler and more direct style of writing.

Reading the book straight through once and then returning to pick out the main thread more clearly, one finds it constructed on an excellent logical plan, proceeding from the primitive unanalysed elements of scientific thinking and advancing by broad historic stages to our present state of knowledge and education. We have first a chapter on the nature of science; a very useful discussion, starting from the mass of interwoven fact and hypothesis which together make up our knowledge and opinion about the world and ourselves, and showing how this has become differentiated into the three main branches with their increasing subdivisions. The three main branches are soundly divided and on the whole accurately described. They are (1) logic and mathematics, to be put either first or last according to our point of view at the moment. These are the sciences of method, if we are proceeding from them upwards, or as the sciences of the highest form of life in thought, if we are reaching them through biology. (2) The sciences *par excellence*, astronomy and physics, chemistry, geology, and biology, those bodies of organised knowledge to which mankind has now universally agreed to give the name of 'science.' From these, naturally, the author draws most of the illustrations in the rest of his book. (3) Psychology and the political and social sciences, of which the methods are as various as the facts with which they deal, and of which the organisation ranges from the correlation of sharply defined concepts to loose classification or mere description.

The second chapter is on the nature of fact, and enters on the historic survey which runs underneath the author's whole treatment of the subject, though it might well, in our opinion, have been made more obvious to the reader. The 'fact' is that 'coercive' thing in our experience from which the mind, at least of man, cannot escape. This is analysed with care and excellent judgment by Prof. Barry, who avoids with great skill the pitfalls of subject and object, idealism and materialism. We trace in selected cases, for example, of silver, the emergence of the more and more exact correlation of analysed aspects of the brute fact, until we reach the form of physico-chemical generalisation to which all scientific theory tends.

This leads us to the third chapter on the "Elements of Theory," in which the point of view changes. We are now considering the elaboration



of explanations as a whole rather than the nature of the facts on which they are based. The author rightly fixes on the Pythagorean problem and the Greek atomic theory as the two most important steps in framing the scientific outlook for all mankind. The first was the question of finding means for the complete representation of continuous magnitudes by discontinuous formulations, and, if found, would give us a united science of number, configuration, and movement. The second is the attempt to arrive at the ultimate elements of matter, of our external experience, to which these 'laws' of number, place, and time may be applied.

The last chapter is called 'Scientific Humanism,' and deals with the present general state of education and of the spirit of the scientific worker, *vis-à-vis* the evolution of science as sketched in the earlier chapters. One is not surprised to find that Prof. Barry ends with the advocacy of the history of science as equally necessary for both parties to this debate, if debate it can be called where the opposing sides scarcely ever come into contact. He puts first its importance for the scientific worker himself; he is speaking, of course, of the average student in science. "It is well known that much scientific instruction in our own day is going stale; exactly as literary instruction went stale two generations ago." It is due, he thinks, to the multiplication of laboratory experiments and problem drill without the true spirit of discovery or any realisation of where the work fits into the greater scheme of human civilisation as a whole. The supreme merit of the study of the history of science is that it "humanises a sort of study which is uniquely severe and impersonal . . . it satisfies the spontaneous curiosities which will be aroused by a good lecturer's references to his own or a colleague's investigations. . . . When seriously pursued it yields an insight into the true character of scientific activity and finally provides the most efficacious means for the more intimate blending of scientific and other interests." "But," he adds in another place, "to serve the purposes of scientific humanism the history of science must be made genuinely educative . . . it must become a serious discipline and not a bedtime relaxation."

It is strange that with such good reasons to support it, with which most readers of this review will be in accord, we still have not in England a society to promote the study of the history of science, such as Augustus de Morgan once founded, or as we now see flourishing and doing so much good work in the United States.

F. S. MARVIN.

### Papuan Magic.

*Orokaiva Magic.* By F. E. Williams. Pp. xii + 231 + 7 plates. (London: Oxford University Press, 1928.) 12s. 6d. net.

IN this volume Mr. Williams has assembled three essays constituting Nos. 6, 7, and 8 of the Anthropological Reports issued by the Government of Papua. As indicated by the title, all three refer to the Orokaiva, the name applied by Europeans to the Binandele-speaking tribes of the lowlands of the Northern Division of Papua, that is, that portion of the great island until recently known as British New Guinea. Of these three essays, the first is by far the most important, the second rather slight, though it contains an interesting account of the rotation of garden areas and the native reasons for the practice. The third, apart from the new material it contains, is interesting as showing how near to a reasonable theory of magic an acute observer and careful reasoner can come, without any overt acknowledgment of recent work on the unconscious, or indeed recognition that it exists. In spite of this it is obvious, at least to the reviewer, that given the same opportunity, this essay could scarcely have been written prior to 1920, by which time ideas as to the importance of the processes of wish-fulfilment and rationalisation as offering reasonable explanations of native thought and customs were beginning to be appreciated. From this point of view such passages as the following are surely most instructive:

"As originally impulsive and truly spontaneous it may be said that the fundamental element in magic consists just in desiring the result, but desiring it in the particular way (*viz.* without any solid, matter-of-fact basis) which we call *wishing* or *hoping*. One might go so far as to say that whoever hopes against hope, whoever dreams by day and builds castles in the air, has already made magic in his heart. Any emotion or blend of emotions may enter into the hope—hunger, anger, lust, revenge, or whatever other. When we are indulging a wish or a false hope and are enjoying a premature imaginary satisfaction of such emotions, we are in spirit guilty of magic."

And again, "another stage in the indulgence of this false hope or wish comes when we utter it aloud in the spell or the apostrophe. When a man wants rain he cries, 'Rain come!' . . . As he plants the taro he cries, *O ba anumbe jo!*—'Taro, sit tight!' (*i.e.* take root), or *Ba erejo*—'Taro arise!'"

So far so good; it is in his next sentence that Mr. Williams, still trusting to his logical faculty, goes wrong (the italics are the reviewer's):



"It is simply a matter of putting what you wish into words, *though you may have no good reason to expect a fulfilment of the wish.*"

Nevertheless, the whole is uncommonly stimulating. The author points out that such exhortations as those cited above are innumerable, and adds that among the Orokaiva "set magical formulae, if they exist, are uncommon," an observation of some importance in that it supports a suggestion made in a review in *NATURE* of June 9 (vol. 121, p. 899) of Dr. Landtman's "The Kiwai Papuans of British New Guinea," namely, that the magic of Papuan (in this context meaning no more than non-Melanesian) tribes might be found to differ from those of the Papuo-Melanesians by the absence or slight importance of those carefully framed formulae or spells which so definitely constitute the most important element in the magic of the Massim. Here at any rate is another Papuan tribe of whom it can be said even more definitely than of the Kiwai that set magical formulae are unimportant.

The "Taro cult," the subject of the first essay, is perhaps the most important of the several new ecstatic 'religions' which have sprung up in New Guinea since European occupation. It has the usual features of cults arising as the result of the clash of European and primitive cultures, namely, possession (dissociation) with a heightened degree of suggestibility leading to rapid even mass conversion, extending in this instance over a considerable geographical area.

The new cult came into existence through the visions of an individual who believed himself possessed by the spirits of the taro, from whom he received instruction in the rites necessary to ensure an ample crop. These rites, which were simple and included feasting and good fellowship, quickly developed into a popular cult with rather elaborate dancing and ceremonial, the whole originally directed toward the placation of the taro spirits, so that the name 'Taro cult' was not incorrectly applied. But since the taro cult largely replaces the slightly older Baigona cult, which originated as the result of instructions received on Mt. Victory from a snake, Baigona, who in orthodox fashion incarnated or at least represented the spirits of the dead, it is not surprising that the taro worship did not spread very far without a significant change. While the ritual remains substantially the same, the great majority of its devotees regard it as placation, not of the taro spirits, but of the spirits of ancestors or departed relatives who are believed to control the growth of the taro.

The taro cult is then in essence a cult of the dead,

though it retains its close association with the taro in that its chief function is to ensure a prosperous taro crop. It is thus at once a fertility cult and a cult of the dead, and in theory at least gives us a glimpse of the possible origin of the many much worn down agricultural ceremonies which exist in other parts of New Guinea, for example, those of the Central District in which the *dubu* plays so large a part, though here (in spite of the enormous amount of vegetable food displayed) there is no question of banana, etc., spirits, and it is only with difficulty that the observer is able to convince himself that the rites are in any way connected with the dead.

Mr. Williams gives a good account not only of the actual symptoms of dissociation, which are those found the world over, but also of the sects or variant cults which have already arisen within the mother ritual, and concludes with some very wise words which should be pondered by every missionary and administrator as to the origin of the movement. He shows that the rapid spread of the cult, in other words its acceptability, is largely due to the suppression of the older interests—he especially instances religion and ceremonial, but he might have included raiding—under the impact of white civilisation, and that it is this suppressed energy which finds expression in the elaborate ceremonial and dissociation states which are characteristic of the cult.

C. G. S.

### Alluvial Prospecting.

*Alluvial Prospecting: the Technical Investigation of Economic Alluvial Minerals.* By Dr. C. Raeburn and Henry B. Milner. Pp. xix + 478 + 32 plates. (New York: D. Van Nostrand Co.; London: T. Murby and Co., 1927.) 36s. net.

PRECEDED by an inspiring foreword by Dr. J. D. Falconer, the main body of the text of the work which is at present under review consists of an introduction and ten chapters dealing, amongst other matters, with the classification, lithology, provenance and association of alluvial and allied deposits and minerals; theories of transport and accumulation; prospecting methods; geophysical aids; field work; the report; and laboratory methods. The book in its aim and scope stands alone. It represents a determined effort to raise alluvial prospecting to the status proper to the initial operations of a branch of the world's second most important basic industry, mining.

The authors successfully show that the old-



time scramble must give way to thoroughly scientific search and clearly demonstrate the ways and means that have to be adopted in this quest. They prove beyond doubt that the modern prospector must have had a liberal scientific training in addition to his possessing the attributes of the many worthy adventurers who led the way in the past and did so much for the world; and they seem to wish that the reasoning used by E. H. Hargraves, who discovered gold in Australia, should be stimulated, developed, elaborated, and utilized in accordance with the requirements of the present day. The authors evidently have in view the facts that as much mineral has been drawn out of the earth during the past few decades as during the whole of the previous period of human life; that low-grade propositions are the order of the day; and that the pioneer must be properly prepared.

By the publication of "Alluvial Prospecting," by the presenting to all who wish to learn the result of their foresight, long labour, and determination, by their breaking new ground, the authors have acted indeed as true prospectors; and they are to be congratulated. Happy, too, are they in having a foreword by such an eminent geologist as Dr. J. D. Falconer, who himself has caused many ideas about natural occurrences to be radically modified.

So if the lengths of the ten different chapters are not of the right proportions according to all minds; if, for example, the pages devoted to prospecting methods are only 53; if none of Sir Arthur Quiller-Couch's purple patches are to be found in the text; if some of the terms used seem new and strange; if "index-suites," "fit minerals," and "unfit species" cause imaginations; if all specimens of cassiterite from Amo, Nigeria, are not magnetic; if the chapter on "The Report" does not follow those on laboratory work; if the mining geologist is rather pushed to the front and the mining engineer, the arbiter to whom the directors will look, is not much mentioned, little matters. For there is in the book, and linked with the indication of a praiseworthy purpose, a mass of information contained in no other single volume; and the weaknesses but show that the authors have not practised the plagiaristic eclecticism so apparent and so common in the common scientific work. Yet it would surely be with the approval of the Institution of Mining and Metallurgy that in the preparation of a second edition all advantage should be taken of what emerges from the relevant discussion taking place under the auspices of that body.

F. W. ARMSTRONG.

### The Explosives Industry in America.

*History of the Explosives Industry in America.* By Arthur Pine Van Gelder and Hugo Schlatter. Pp. xxxviii + 1132. (New York: Columbia University Press; London: Oxford University Press, 1927.) 50s. net.

IN both Great Britain and the United States the explosives industry has formed one of the most important nuclei round which the powerful chemical combinations now existing in these two countries have developed. A history of the British explosives industry, edited by E. A. B. Hodgetts, was published in 1909, under the direction of the Explosives Section of the seventh International Congress of Applied Chemistry; the present publication deals with the history of the explosives industry in the United States and Canada, and to some extent in Mexico and South America. It has been written and published under the auspices of the Institute of Makers of Explosives, and the material has been collected from pioneer workers who are still living, from the records and archives of large powder companies, and "for the earlier history, more particularly the origins of the black powder business, data have been found in colonial records and local histories of towns, counties, and states."

The history treats largely of the rise and development of the large powder companies of the United States, with the vicissitudes through which they passed, and it contains biographical details of the personnel of the industry. The technical development is also dealt with. The crude methods of manufacture and control adopted by the early pioneers, with the numerous catastrophes which occurred, have no counterpart in Great Britain, where the first steps of the high explosives industry were controlled by the administration of the Explosives Act of 1875. It is of interest to read that "the use of nitroglycerine as such for blasting purposes was apparently widespread at this time," and that although Congress passed a law in 1866 prescribing the methods of packing and transport, there were many attempts at evasion.

The scope for the employment of high explosives in the rapid opening up of the United States was enormous, and one part of the book gives an account of the different mineral industries which have been developed and of the various engineering projects carried out with the help of explosives. Dynamite was one of the essential materials required for the construction of the Panama Canal; it is recorded



that in the largest individual blast carried out 80,000 pounds of dynamite were used.

The book is divided into six parts, dealing respectively with black powder, nitroglycerine, and dynamite, blasting supplies, including the necessary accessories, detonators and fuses, smokeless powder, including both sporting powders and military powders, military high explosives, largely concerned with trinitrotoluene, and, finally, the part referred to previously, dealing with explosives in the making of America.

The book is well got up; it is profusely illustrated with portraits of those who have been concerned in the development of the industry, and with photographs of factories, plants, and machinery, and of a number of interesting blasting operations and their effects. It will probably not appeal to a wide circle, but will be read with considerable interest by all who have any connexion with the explosives industry.

### Our Bookshelf.

*The Unconscious in Action: its Influence upon Education.* By Barbara Low. Pp. 226. (London: University of London Press, Ltd., 1928.) 5s. net.

MISS BARBARA LOW'S "Unconscious in Action" is an attempt to show the importance of psycho-analytic theory in the explanation of character formation. At the same time it is a plea for the use of analysis in the school-room. The author does not, indeed, advocate psycho-analysis of children by their teachers; but she does desire to see the teachers themselves analysed so that, understanding the complex tendencies of their own 'unconscious' and its mechanisms, they may the better appreciate the potentialities for good and evil of the hidden forces lying in the depths of the child-mind. Thus, knowing himself, the teacher will realise the influence of the 'unconscious' upon consciousness, the way in which 'repressions'—fruitful causes of mal-adjustments—are brought about, the dependence of the intellectual life upon the emotional, the rôle of fantasy, and the like; and he will make use of his knowledge in helping the child to adjust himself to reality. Moreover, understanding the 'unconscious' and its mechanisms, he will at least know when to call in the professional analyst as need may arise.

Miss Low is a convinced, orthodox Freudian. Many, acquainted with Freud's teaching in crude, popular, even prurient, vulgarisations, would not allow that the analysis of children could do anything but harm. The popular vogue for psycho-analytic theory and practice has done it thus much disservice. Miss Low, however, is restrained and temperate in what she has to say. She certainly makes out her case for the understanding by the teacher of those forces upon which he plays, knowingly or ignorantly, in his rôle of educator. She

makes out a case for the prudent guidance of children along the lines of dynamic psychology. There can be no doubt that education has waited too long for a satisfactory dynamic theory of mind upon which to base its practice. Her theory is Freud's, whose work has done so much to stress the influence of human relationships upon the development of character. But the foundation upon which she builds, notwithstanding Freud's noteworthy contributions to it, is even broader and more solid than the theory of Freud. The details of Freud's views, psychological and philosophical, are still open to criticism; not so, however, his contention, general in modern psychology, of the essentially dynamic nature of the mind.

*Creatine and Creatinine.* By Prof. Andrew Hunter. (Monographs on Biochemistry.) Pp. vii + 281. (London: Longmans, Green and Co., Ltd., 1928.) 14s. net.

ALTHOUGH our knowledge of the physiology of creatine, up to within the last year or so, has been remarkably meagre in spite of many investigations on the subject, we are grateful to Prof. Hunter for collecting the data in one volume and critically reviewing the results obtained. It appears probable that recent work on the occurrence of a labile compound of creatine and phosphoric acid in muscle will explain much that has been obscure about the function of creatine in the body, so that the present moment appears opportune for summarising our knowledge and providing a suitable foundation on which future investigators may build.

The author commences his monograph with a description of the discovery, synthesis, and constitution of creatine and creatinine, and then considers the general chemistry of the two compounds and their derivatives. Detailed descriptions of their preparation and quantitative estimation serve as an introduction to an account of their biological distribution: both compounds appear to be confined to vertebrate tissues and completely absent from invertebrate: creatine is found chiefly in the skeletal muscles, probably in labile combination with phosphoric acid, whilst creatinine occurs chiefly in the urine. Creatine is not usually excreted by healthy men, though it occurs as a constituent of the urine in children, in women at certain times, and in certain cases of disease, chiefly of the muscles. The author considers that there is now sufficient evidence to conclude that the urinary creatinine is derived from the muscle creatine, a statement which might have seemed obvious, yet for which direct evidence has been singularly difficult to obtain. It is probable that the conversion of creatine to creatinine is a purely physico-chemical process dependent solely on the temperature and reaction of the tissues, especially the muscles.

It appears certain that creatine has a definite function to perform in the organism and is not simply a waste product: it is presumably derived from protein, possibly from the amino-acid arginine, although its exact precursor has not been definitely determined. The monograph concludes with a



bibliography of thirty pages, the majority of the references having been verified by consultation of the original papers. It should find a place in the library of all physiologists.

*Modern Industry.* By Prof. Ernest L. Bogart and Prof. Charles E. Landon. (Longmans' Economic Series.) Pp. x + 593. (New York and London : Longmans, Green and Co., Ltd., 1927.) 16s. net.

IN their book on "Modern Industry" Messrs. Bogart and Landon have systematised the subject and co-ordinated the various aspects, striving to arrive at, and drive home, their views by the rigid application of a logical decision based upon the consideration of contrary arguments. But whilst admitting their skill, differences of opinion may still arise. They exhibit an American crispness of diction, which is incisive and pleasant, and with much of the text there cannot fail to be agreement ; but in some places the authors attempt to prove too much ; one example will suffice : "the soldiers, policemen, judges, and others who have maintained peace and order" may all claim a share in the production of any stated sample of manual labour ; they would also allot a share to "the owners of the land and buildings where the work is produced," and there are still others to be regarded as co-operators. Such notwithstanding, the book is replete with cogent statements and well-conceived arguments ; but no good is effected by depreciating the scientific attainments of past civilisations, in order to enhance the reputation of to-day. The six hundred pages are full of interest, and to very many of us the work will appeal as the gospel of machinery and mass production in contrast with individualism and the satisfaction of human needs as and when they arise.

P. L. M.

*Our Wonderful Universe : an Easy Introduction to the Study of the Heavens.* By Prof. Clarence Augustus Chant. Pp. 191. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1928.) 5s. net.

IN spite of the considerable number of elementary works on astronomy, this pleasant little book by Prof. Chant can scarcely be regarded as redundant. It is intended mainly for juveniles, though older people who require a very simple account of the heavens will find it perfectly readable, and will look in vain for pictures of oranges, balls of knitting, lamps, and other similar accessories frequently found in such books. The matter is almost entirely descriptive, dealing with the physical aspects of the heavenly bodies rather than with instruments, methods of observation, or theoretical considerations ; an important feature of the book, therefore, as might be expected, lies in its illustrations. There is a large number of well-chosen pictures, among which special mention may be made of some excellent reproductions of planetary photographs taken by Dr. Wright in ultra-violet and red light ; but some of the 'bird's-eye' views might be improved by the omission of what appear to be cumulus clouds. By the aid of these illustrations a very clear picture is presented of the universe as conceived by astronomers, and the book can scarcely

fail in one of its prime objects, namely, "to excite the wonder of young people, to fire their imagination, and to convey to them some notion of the majesty, the mystery, and the sublimity of it all."

*Philips' Pocket Surveyor.* Designed by George C. Sherrin. With 16-page Pamphlet. (London : George Philip and Son, Ltd. ; Liverpool : Philip, Son and Nephew, Ltd., 1928.) 2s. 6d. net.

THE "Pocket Surveyor" is a simple and ingenious mechanism for which it is claimed that it is always ready for 'spotting' levels, calculating heights of buildings and trees, gradients and areas ; for setting right angles for sports grounds ; for simple map-making and contouring. It is, however, difficult to imagine anyone seriously undertaking these duties with the instrument. The claim seems rather that where these calculations are not a matter of serious concern, the instrument might be used by way of instructional amusement. This is probably true, and one can well imagine "scouts, rovers, cadets, and members of similar organisations" using it as they might any other 'gadget.' The contention, however, that teachers of geography will appreciate the value of this device, "by which simple maps may be constructed, the areas of fields calculated, and the mysteries of contouring unravelled," is surely owing to a fundamental misconception of so-called 'practical geography.' Admittedly, pupils are not expected to produce a finished Ordnance Survey map, but if they do such work at all, apparatus, however simple, should be used which introduces the principles of the standard instruments. To suggest that in any circumstances the "Pocket Surveyor" can do or teach the work of survey instruments is misleading and inadvisable. As an instructive toy it is excellent.

*The Geology of Malayan Ore-Deposits.* By J. B. Scrivenor. Pp. xv + 216. (London : Macmillan and Co., Ltd., 1928.) 16s. net.

THE Malay Peninsula is of especial geological interest both academic and economic. The primary facts regarding it are uncertain owing to the contradictory accounts of Mr. Scrivenor, the Government Geologist, Mr. W. E. Cameron, the former Government Economic Geologist, Dr. W. R. Jones, and Dr. Rastall. Mr. Scrivenor remarks that the confusion "has rarely, if ever, been equalled in geological literature." We therefore turn to this attractive volume in the hope of finding a solution of the difficulties. It should close one of the controversies, for the author abandons his claim for the Permo-Carboniferous age and glacial origin of some boulder beds, and accepts them as modern alluvial deposits. In other respects, however, the issues still remain obscure ; for though Mr. Scrivenor remarks that the conclusions in Dr. Rastall's recent papers should be used as a basis of discussion, he is obviously doubtful about them. The author's account does not carry conviction as to whether in Malaya there are two distinct series of granites, and whether some of it is of Upper Mesozoic age. The book leaves some of the fundamental facts of Malay geology in unfortunate uncertainty. It contains a concise and useful account of the chief tin mines.



### 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.]

#### Radio Echoes and Magnetic Storms.

PROF. STØRMER'S letter (NATURE, Nov. 3; p. 681), on radio echoes heard from 3 to 15 seconds after the signals, raises some interesting points. If the cause is as he suggests, namely, streams of electrons from the sun, associated with auroræ, the observations would seem to give the first direct evidence yet obtained as to the density of these streams, since the reflection of waves of 31.4 metres, at normal incidence (as is necessary for the signals to return to the earth from a great distance), requires an electron density of the order  $10^5$  to  $10^6$  per c.c.

Prof. Størmer mentions electrons only, but these must be accompanied by positive ions in approximately equal numbers (assuming them to be singly ionised), since a stream of this order of density, even if it were not practically neutral on emission from the sun, would become so in its passage to the earth, by dispersal of its excess charge. The positive ions will play only a minor part in radio reflection. It is of interest to note that the density of the stream, according to the above estimate, is similar to that of the solar chromosphere. Since the thermal motions of the ions must cause an expansion of the stream during its passage from the sun, the density at emission must be greater.

The fact that the electrons must be accompanied by positive ions will render their motions in the earth's magnetic field very different from those deduced by Prof. Størmer in his valuable mathematical researches on auroræ; Mr. K. C. A. Ferraro and I have made some calculations on this subject, which we hope to publish shortly. The charges in a neutral stream may become separated to some extent by the field, in the earth's neighbourhood, but this can scarcely occur to any extent at the distance of about 200 earth-radii at which the radio signals are supposed to be reflected.

S. CHAPMAN.

Imperial College of Science and Technology,  
S.W.7, Nov. 7.

IN NATURE of Nov. 3 there is a letter by Prof. Størmer which I find exceedingly interesting. Although I have never observed the short wave echoes of 3 to 15 seconds' delay reported by him, I have other observations which bear closely on this matter and seem to afford a striking confirmation of his conclusions. These observations refer to a peculiar class of atmospheric, which from their musical nature are appropriately termed 'whistlers.'

It has been known now for some years that if a telephone or any audio amplifying device is placed in series with a big aerial (eliminating all high frequency circuits and rectifiers), disturbances of a musical character can be heard on appropriate occasions. These can be divided into two classes, the short whistlers and the long, but both are characterised by the fact that the disturbance starts with a note of high pitch, which drops rapidly in the first class and slowly in the second class to a note of low pitch, i.e. about 200 to 500 cycles per second. The first have been described by me, *Phil. Mag.*, vol. xlix., June 1925, where it is shown that these disturbances are probably produced by an electrical impulse, the component frequencies of which, travelling with different group

velocities in the medium, are drawn out into a disturbance of a musical character.

The resemblance between the long and short whistlers suggests that the mechanism is the same in both cases. The observations which bear on Prof. Størmer's results have been made during the past nine months on the long whistlers. The observations have been made daily, and the following general statements may be made:

(1) Whistlers are definitely associated with magnetic storms. That is to say, the frequency of occurrence of these is enormously greater on magnetically disturbed days than on quiet days. During quiet times days may pass with only occasional 'whistlers.'

(2) On many occasions the whistlers occur in groups of echoes preceded by a violent click. The time interval between the click and first echo is approximately 3 seconds, and between each succeeding echo about 3.80 seconds. As many as seven echoes have been heard. Each succeeding whistler is spread over a longer time than the last. The number of echoes and the time interval between them both vary considerably from time to time.

Although there is not sufficient space in a short letter to go into the significance of these results in detail, the connexion between them and Prof. Størmer's long echo is obvious, and one may assume that the mechanism is the same. One may perhaps surmise that the original pulse is produced by a group of charged atoms shot out by the sun and abruptly stopped at the earth's atmosphere; the resulting pulse spreads into the toroidal ring and circulates round it perhaps five or six times before it is finally extinguished. The region within the ring must be slightly dispersive, an electronic density of about one electron per c.c. being sufficient to draw out the pulse into its spectrum of frequencies. The attenuation must be exceedingly low, which suggests a region of very low density.

Whatever the mechanism may be, it is clear that the two sets of observations confirm each other, for if it is possible to have short wave echoes of 3 or more seconds' delay, the explanation that the 'whistler' is a dispersed pulse delayed in travelling by the same interval of time is clearly feasible.

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#### The 'Dimensions' of Society.

A REMARK of Dr. D. A. Robertson was quoted in NATURE of Sept. 8 last, p. 383, by the reviewer of the book on "American Universities and Colleges": "When the world's work has been analysed and the skills and qualities required for particular jobs have been specified, the schools and colleges can shape their curricula . . . more . . . effectively. . ."

Doubtless many methods of analysing men's work can be devised. This note presents a classification in six fundamental categories. These have been selected not by a sociologist but by a physicist. To put forward, however tentatively, a system for cataloguing human activities, in the columns of a periodical devoted to the natural sciences, may seem an anomaly. The justification is this: *logic* and *methodology* are capable of transmitting mutual interactions between the disciplines which deal with Nature and those which deal with man. To the extent that modes of thinking may formally be described, independent of the content of thought, the analytical methods which have been developed in the physical sciences possess general significance.

The passage from empiricism to understanding can



only be accomplished in any field after appropriate categories have been selected for description of the specialised phenomena. The beginnings of modern mechanics are associated with the choice, during the seventeenth century, of what are now called the three 'physical dimensions'—distance, time, and mass—as the essential terms for the description of mechanical events.

Of course, a vast amount of study, following this choice, was necessary before the numerous theoretical and applied formulæ of dynamics were developed. Progress would have been impossible, however, had reliance been placed, in discussions of mechanics, on such fallacious categories as 'fire, air, earth, and water.' For the social sciences (history, political theory, economics, and others), terms of validity and usefulness comparable to the 'physical dimensions' have still to be discovered.

Indeed, it is customary nowadays to doubt whether the logical structure of the social sciences can ever be made as clear-cut as that of physics. Even in an age when concrete results of scientific investigation are beginning to be made everywhere manifest, faith in the existence and power of principles which march with phenomena is still far from general. This much seems certain: the accomplishment or approximation of such a result would have a deep influence on the natural sciences. The brilliance of achievement in these has operated during late years to make unilateral rather than bilateral the interactions between the natural and the social sciences. The mechanistic mode of thought influences our general culture, but the laboratory becomes isolated.

Effective counter tendencies may be expected to develop. Champions of humanism, having found the mace of suppressive legislation, the lance of rhetoric, and the armour of prejudice, alike inadequate to save cherished tenets, must have recourse to the weapons which a modern logic can manufacture. If physicists are true to their traditions, they will criticise with spirit but with tolerance attempts to transcend the logic which has long been supreme in their subject. That logic has usually seemed, to humanists, unduly limited. Nowadays there are indications that it lacks full authority within the bounds of the science of physics itself. As yet it has failed to encompass satisfactorily the *selective* activities associated with the states of atoms.

For more than a dozen years, in a period of intense endeavour, physicists have been constructing an empirical presentation of this 'natural selection' which they observe. We await with interest the transmutation of this empirical presentation into a rational one. Such transmutation may burst the bounds of the old logic: the selection which is in Nature may not be 'natural' in the traditional sense.

If this is indeed the case, the situation does not lack parallels with the situation which existed at the time when the founders of modern science were struggling to free their thought from the limitations of medieval dialectic. We cannot as yet decide. Whatever the outcome, investigators of philosophical trend are not untrue to the scientific spirit if their search for new modes of picturing the realities of physics leads them to examine a variety of data conventionally regarded as irrelevant.

Remembering that observation, not prophecy, is the test of hypothesis in the sciences, we return to the principal thesis of this note. The following list of 'essential' terms is justified in the degree that it permits a co-ordinated view of the entire field of purposeful (or selective) behaviour of men and women, to whom civilisation is more precious than appetite.

TABLE OF OCCUPATIONS WHICH TYPIFY THE  
'DIMENSIONS' OF SOCIETY.

<i>Objective.</i>	<i>Organising.</i>	<i>Æsthetic.</i>
(1) Labourers	Adventurers	Sportsmen
(2) Artisans and clerks	Foremen	Connoisseurs
(3) Scientists and scholars	Engineers and 'executives'	Critics
(A) Inventors	'Entrepreneurs' or 'promoters'	Decorators
(B) Legislators and jurists	Statesmen (on whatever scale)	Educators
(C) Philosophers	Religious leaders	Artists

Each of the terms in the list is to be understood in its ideal and abstract sense. For example, many active members of a given legislature may not be qualified as legislators; while much work that must be done by investigators in science falls under 'labour,' or 'craftsmanship,' or 'invention,' or 'adventure.' The shortcomings of words when employed as mathematical symbols are such that at least a paragraph would be required to clarify the meaning of each term employed.

In so far as this classification is accurate and inclusive, it is an aid for criticism or construction of definitions of 'progress,' of ideas of civilisation, of political and social programmes, schemes of education, evaluations of individuals, and the like. Phases of human activity should be analysable into 'components' along each of the 'dimensions,' just as the geometer resolves the curves of a sculptured masterpiece into  $x$ ,  $y$ , and  $z$  components in space.

In so far as this classification represents an outcropping of a generalised logic, which is capable of dealing with values as well as with facts, it possesses very broad implications.

JOHN Q. STEWART.

Princeton, N.J.

### The Immunity to Adder Venom of Slow-worms, Frogs, and Toads.

It is commonly believed that all creatures are subject to the destructive propensities of snake venom. I have, however, been able to show that two or three species, at any rate, in the animal kingdom are immune to adder poison.

Some time ago I carried out a series of experiments to ascertain and determine the effect of adder bites on frogs. I experimented on three different frogs with three different adders, and the result in each case was that the venom had no apparent physical effect on these creatures. There could be no doubt whatever of the fangs penetrating the skin, because the reptiles bit the frogs so viciously, and the fangs were driven home with such force, that the adders had some difficulty in withdrawing them. Therefore the inoculation was an absolute certainty. I was so astonished at the negative result of my experiment that I began to suspect that the mechanism of the poison apparatus must have been defective or faulty, although this would have been most unlikely to happen in three different specimens.

I decided to submit my experiment to a final test. Accordingly, I experimented with one of the adders above referred to, on a large brown rat. The adder bit the rat on the upper part of the left hindleg, and practically simultaneously with the bite the hind quarters of the rat became paralysed, rendering the creature quite helpless. It lived for an hour and a quarter after being bitten; the respiration became faulty and spasmodic, gradually slowing down until the animal died of slow suffocation. The venom of



the adder contains a high degree of blood-destroying element, which involves the disorganisation of the nerve centres which govern respiration.

I have also carried out a similar experiment with toads, and the result in each case was exactly the same as in the case of the frogs. Moreover, I made microscopic slides of toad's blood mixed with adder venom. A microscopic examination of the slides shows the corpuscles intact—quite normal (Figs. 1 and 2). I

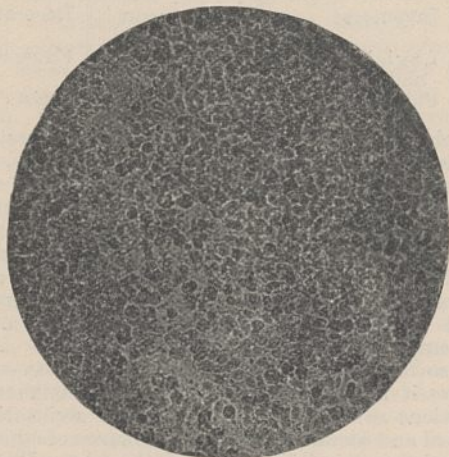


FIG. 1.—Toad's blood, showing corpuscles intact after infection with adder venom.

have already mentioned that the poison is a blood-destroying or hæmolytic element. Therefore, the corpuscles in the toad's blood, after being subjected to an injection of adder poison, should have been disintegrated and destroyed.

My next experiment was with slow-worms (*Anguis fragilis*). I allowed two slow-worms to be bitten

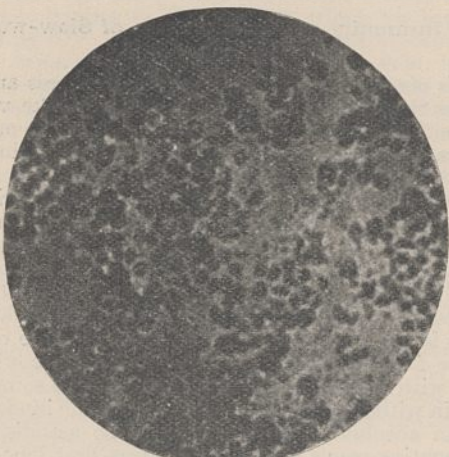


FIG. 2.—Toad's blood, normal.

repeatedly by three different adders, yet the poison had no physical effect whatever on these reptiles. They lived with me in captivity for weeks afterwards, and became quite tame. Microscopic examination of the infected blood stained with hæmatoxylin showed the nuclei much enlarged—otherwise the corpuscles were intact.

I have also submitted a lizard to the fangs of an adder, and the creature was dead twelve minutes exactly after being bitten. It is interesting to note that the slow-worm and the lizard (*Lacerta vivipara*) are, zoologically speaking, first cousins; that is, they belong to the same family (sub-order Lacertilia).

Still, the former is immune to the lethal action of adder venom, while the latter succumbs to its deadly potency.

This strange immunity suggests that the blood of the frog, toad, and slow-worm contains a powerful antitoxin element which immediately neutralises the action of the adder poison, or it may be partly due to a dermal arrest.

N. MORRISON.

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Argyll.

#### Evidence of Survival of a Human Personality.

WILL you permit an old student of ancient and modern psychical phenomena, and a staunch supporter of modern experimental science, to make the following observations on Dr. Tillyard's letter and the editor's comments thereon in NATURE of Oct. 20 (pp. 606-7)?

1. Men of science rightly demand that they should control the experiments, but they seem unable to suggest in what way the method by which experiments are conducted should be revised; and until they know more about the laws controlling the matter involved in the phenomena, they will not be in a position to do so. "The novel atmosphere of the séance room and the unexpected events that take place there," should suggest novel and unusual methods of procedure. As the methods of control used in *physical* experiments vary with the nature of the physical energies under examination, so the methods of control in *psychical* experiments should be adapted to the energies operating in such phenomena.

2. Opinions may and do vary as to the adequacy of the 'tests' to prevent fraud, but such tests, however necessary, are purely negative and preliminary, and have nothing whatever to do with the real science of the problem—if 'science' means control of Nature by knowledge of her 'laws.'

3. Isolation is the fundamental requirement in scientific experiment, but we have not discovered what provides the necessary isolation for the creation and growth of organisms. The inner polar conditions of the organism itself must isolate it and adjust the operations of Nature. Every normal human being must be automatically isolated in the same way as animals, or their forms could not be preserved; and a man must be isolated also mentally (or psychically) to maintain his individuality. How is this done? What is the result if the isolation be broken through, the polar balance disturbed? How can it be restored? I think these questions are pertinent to mediumistic phenomena.

4. Mere reflection on what we already know from scientific research regarding the principles and processes of creation should lead to a comprehension of the utter worthlessness of resemblance in a 'materialised spirit' as a proof of identity: the possible reproductive, reflective, and imitative powers of Nature seem limitless. If electrical energy can record and echo our voices, why cannot it reproduce and echo our thoughts?

W. W. L.

Oct. 20.

[The points raised by W. W. L. in the above letter go to the root of certain of the difficulties inherent in psychical research. The duty of the scientific man is to attempt to discover the causes of so-called psychic phenomena; to ascertain the 'laws' which govern them, and then to form some theory which can be said properly to describe them. Working hypotheses are excellent, but they should at least be brought as near as possible to the known world before seeking help in the unknown.]



The methods of investigating mediums must naturally be adapted to circumstances, since, as in experimental psychology, the human factor is concerned. But at present the investigations, if they can be called such, are carried out under the necessity of obeying sets of purely arbitrary and unproven 'laws,' invented by spiritualists and others, of which the chief result seems to be to prevent exact knowledge being acquired.

Doubtless it is possible, although in our opinion improbable, that psychic phenomena can only occur under conditions which render it impossible to ascertain their real nature. It may be that, in the case of experimental telepathy, for example, if we exclude normal processes such as codes, etc., the supernormal element cannot come into operation. If this be so, it is clear that science must prefer the theory that normal causes are sufficient, even though it may be difficult to determine precisely at each point what kind of normal factor is active.

Until we know more of the unknown elements said to be present in psychic phenomena, it is premature to discuss theoretical considerations. Knowledge can only be obtained by careful systematic investigation, by free, unhindered inquiry, and by exact and varied experiment. When results are obtained under these conditions which can be compared and verified in a number of cases, it will be time to determine whether the extension in our knowledge demands an appeal to extra-mundane influences.—THE EDITOR.]

#### Active Nitrogen.

In a brief discussion of active nitrogen in NATURE of Sept. 15, by Mr. C. N. Hinshelwood, there are several statements which should be modified in view of some recent work done by several investigators.

The statement is made in the article: "In the presence of more than about 2 per cent oxygen, the nitrogen does not glow at all." This has been shown to be wrong. I have shown that active nitrogen is produced when a condensed discharge is passed through air at 0.5 mm. pressure (*Proc. Nat. Acad. Sci.*, 14, 258; 1928). Herzberg (*Zeit. f. Physik*, 46, 878; 1928) showed that it was possible to produce glowing active nitrogen in mixtures of nitrogen and oxygen in which the percentage of nitrogen varied from 100 per cent to 40 per cent. Earlier than either of the above experimenters, Hagenbach and Frey (*Phys. Zeits.*, 18, 144; 1917) showed that glowing active nitrogen could be produced from air. The spectra observed by all these authors was the same as that obtained from active nitrogen that has been produced from almost pure nitrogen.

Elsewhere in Mr. Hinshelwood's article the statement is made that a few of the first positive bands of nitrogen are prominent in the afterglow and "the rest entirely absent." Rayleigh observed in one of his earlier spectroscopic investigations of active nitrogen (*Proc. Royal Soc.*, 85, 377; 1911) that in addition to the very prominent bands in the afterglow, other bands of the  $\alpha$  group appeared. At the time that these bands were observed, Rayleigh ascribed them to stray light from the discharge tube or to stray discharges. In a later paper (*Proc. Royal Soc.*, 102, 453; 1922) Rayleigh photographed these bands again, and definitely assigned them to the afterglow. During the past year Dr. G. Cario and I have photographed the afterglow in the visible and in the near infra-red, and it has been found that practically the entire first positive group of nitrogen is present in the afterglow. The idea, therefore, that the afterglow spectrum consists of only a few selected bands of the first positive group is wrong. A full account of this work is to appear soon.

We wish further to discuss the statement that the assumption of metastable nitrogen molecules in the afterglow must be made "directly for the purpose of explaining the facts, and without independent evidence." The first electronic level of the nitrogen molecule is known as the  $A$  level and possesses about 8 volts energy. This level has long been suspected of metastability because of the absence of transitions between it and the normal level in either emission or absorption. The absence of these transitions is in agreement with the assignment of the  $A$  level to the triplet system and the normal level to the singlet system, since intercombinations are highly improbable. Other experimental evidence as to the existence of metastable molecules in active nitrogen has been given by me (*Phys. Rev.*, 31, 1126; 1928). Both of these pieces of evidence are independent of any theory as to the nature of active nitrogen and should therefore be considered in proposing any explanation of active nitrogen.

JOSEPH KAPLAN.

Department of Physics,  
University of California,  
Los Angeles, Cal., Oct. 6.

It is interesting to know that under certain conditions the glow can be produced in presence of air: the fact, however, remains that under those used by Lord Rayleigh oxygen destroyed it.

I take it Dr. Kaplan does not suggest that the prominent bands are other than those described by Rayleigh, or that the intensity relationships are not much displaced. This still seems the most important fact, though it is also interesting that the other bands can be found. Dr. Kaplan does not mention the intensities of the bands he and Dr. Cario find. Presumably they are very faint.

I have not yet read Dr. Kaplan's paper in the *Physical Review* of 1928: but the first piece of evidence mentioned does not seem to me to be more than a suggestive analogy. I agree at least that it is that.

C. N. HINSHELWOOD.

#### Secondary Absorption Edges in X-rays.

RECENTLY Nuttall (*Phys. Rev.*, 31; 1928) has examined the X-ray absorption spectra of simple compounds like potassium chloride and found six absorption edges (designated as  $A, B, C, D, E$ , and  $F$ ) both for potassium and chlorine atoms, all of which lie on the short wave-length side of the primary  $K$ -limit. The wave-lengths of the first four of these agree well with those found by Lindh in chlorine compounds of different valencies.

Following the well-known theory of Kossel that the fine structure limit should in no case exceed the ionisation potential of the atom, Coster, Robinson, Stoner, Lindsay, and others have tried to explain the secondary edges which lie outside the fine structure limit as due to the multiple ionisation of the atom. On this view, then, the frequency of the characteristic emission lines of these ionised atoms will be changed so much as to be clearly resolved by the spectrograph (Ray, *Phil. Mag.*, vol. 1; 1925), but no such large shift in emission has yet been observed. Thus neither the valency nor the ionisation theory explains satisfactorily the presence of these absorption edges. I believe that a simple explanation of these observed phenomena can be given on the following lines:

In the ordinary absorption phenomena the energy in the incident radiation is utilised in removing an electron from one of the energy levels (say  $K$  level) to levels which lie beyond the periphery of the atom. Radiation of higher frequencies is also absorbed and



the excess of energy is utilised in imparting kinetic energy to the ejected electron. In order to explain the secondary absorption it is assumed that not only can a quantum of radiation be absorbed by a single electron in an atom, but also that the same quantum can be absorbed successively by two or more electrons occupying different energy levels in the atom. Those quanta which can thus successively remove two or more electrons (say one from the  $K$  and the other from the  $M$  level) out of the atom, will be selectively absorbed and will therefore appear as absorption edges on the shorter wave-length side of the primary  $K$  limit.

The process of first absorption of the incident quantum by the atom mainly determines the position of the secondary edge and may take place in a number of ways. Thus the incident quanta may knock an electron from the valency or from the  $M_2(M_{II}, M_{III})$  or from the  $M_1$  shell, either to some higher optical level or to infinity (zero energy), or may raise the electron from  $M_1$  to  $M_2$  level, if there is any space for it, and thus give rise to a number of possibilities for the appearance of the secondary  $K$  edges. From the interpolated values of higher levels of the atom from X-ray and from optical data, a rough calculation is made of the shift of these edges, and the following table shows the observed (Nuttall) and the values calculated according to the point of view taken in this paper for chlorine. Here the combinations are of the types,  $\nu_K, \nu_K + \nu_{R_\infty}, \nu_K + \nu_{M_2}, \nu_K + \nu_{M_1}, \nu_{M_2}$  and  $\nu_K + \nu_{M_1}$ , where the subscripts  $K, M_1$ , and  $M_2$  denote energy for  $K, M_1$ , and  $M_2$  shells,  $R$  the resonance level (optical), and  $R_\infty$  the change from resonance level to infinity.

	A-B	A-C	A-D	A-E	A-F	A $\rightarrow$
Observed	4.0 v.	10.9 v.	15.5 v.	19.2 v.	27.3 v.	above 50 v.
Calculated	4.2 v.	8.9 v.	13.4 v.	17.6 v.	27.4 v.	„ 40 v.

Similar calculations have also been made in the case of potassium and calcium in close agreement with the observed values of Lindsay and Van Dyke (*Phys. Rev.*, 28; 1926). Details of the calculations, the mechanism of double absorption, and also the question of intensity will be dealt with in a subsequent communication.

B. B. RAY.

University College of Science,  
Calcutta, Sept. 27.

### An Experimental Test of Schrödinger's Theory.

ACCORDING to Schrödinger's theory, the intensity of an expected line in emission is not determined by the number of atoms in the higher level and the coefficient of spontaneous emission, but by the populations of both the higher and the lower levels corresponding to that line. If we have then two lines emitted by the same higher level, their relative intensity ought to change if we change the relative population of the lower levels, and furthermore, the change in the relative intensity of the lines should be equal to the change of the relative populations.

This conclusion has been tested experimentally, using mercury vapour at room temperature, optically excited, in which the two lines 4358 Å. and 4046 Å. emitted by the same higher level  $2^3S_1$  appear in fluorescence with great intensity. The relative population of the two lower levels  $2^3P_1$  and  $2^3P_0$  can be changed several hundred times by introducing a few millimetres of nitrogen or water vapour into the tube containing the mercury vapour. In fact, when mercury vapour alone is in the tube, the absorption of 4358 is several times stronger than the absorption of 4046, showing that the population of the resonance level is several times greater than the population of the metastable level; if a few millimetres of nitrogen or water

vapour are now admitted in the tube, 4046 is very strongly absorbed and the intensity of the lines 4358 and 4046 in fluorescence increases about twenty-five times as found by R. W. Wood. A simple calculation shows that the number of metastable atoms must be now at least 100 times larger than the number of resonance atoms (see E. Gaviola, "The Influence of Foreign Gases on the Optical Excitation of Mercury," appearing in *Phil. Mag.*).

The enormous increase in the number of metastable atoms is due to the fact that collisions of the second kind with foreign gas molecules bring resonance atoms down to the metastable level, where they accumulate owing to the long mean life of this level. The relative population of the two lower levels has changed, then, at least several hundred times, due to the admission of gases, and, according to the theory, the ratio of the intensities of the lines 4358 and 4046 in fluorescence should also change in the same proportion. This ratio has been carefully measured without and with foreign gases, avoiding re-absorption of the fluorescence lines in the excited vapour by using a very narrow beam of primary light, and choosing such a pressure of the foreign gas that metastable atoms do not diffuse out of the illuminated region, and the result is that the ratio mentioned is equal to 2 in the case of mercury alone and equals 2 in the presence of nitrogen or water vapour. This proves conclusively that in our case the ratio of the intensities of the lines in emission does not depend on the populations of the lower levels, in contradiction with the common interpretation of Schrödinger's theory.

Details of calculations and measurements will appear in another place.

The experimental part of this investigation was done in Prof. R. W. Wood's laboratory in the Johns Hopkins University.

E. GAVIOLA.

Department of Terrestrial Magnetism,  
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Oct. 6.

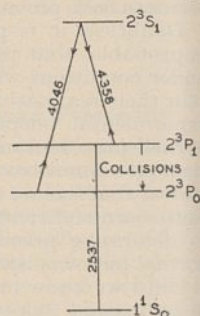


FIG. 1.

### Work and Place of Amateurs in Science.

IN NATURE of Aug. 18, under the heading of "Biography in American Science," attention is directed to the scarcity of amateur scientists, that is, to that class of them who have reached some degree of success in research. The word amateur, however, in its common meaning is applied to a large number of persons who are inexperienced and with only a superficial knowledge of the subject. Most of these are entirely different from the amateurs referred to in the article in NATURE, and we need to coin a new word or term to designate the amateur scientists who are experienced in research and have a broad knowledge of the subject.

The word amateur in its strict and original meaning is rather complimentary. But in our dictionaries, immediately following the word amateur is the word amateurish, which is defined as "Superficial or defective like the work of an amateur." So this definition is a rather uncomplimentary reflection on the amateurs.

The term amateur scientist as it is commonly understood might include all persons who are naturally interested in some scientific subject and make a study of it; the time devoted to it and their knowledge of their subject may vary greatly with different



individuals. There are others whose interest is only indirect; thus an amateur might make entomology his hobby, while his real interest is in the enjoyment of the excursions to the country. There is also a large group who have but little originality or interest in science for the sake of truth, but dabble into some subject expecting to take it up as an occupation later. All this is more or less creditable to these amateurs, but does not make them scientists.

The amateur scientists referred to in the article in *NATURE*, who not only pursue science for the interest in the subject itself and without compensation, and also put in their money to carry on their research, are different from the ordinary amateurs in having a deeper knowledge of their subject and in being experienced in the research and special study of the subject; they may be even more experienced in their special subject than many professional men of science, except the few who also make a special study of the same subject.

There is a tendency to discourage and ignore the theories and discoveries of unknown amateur scientists. A discovery should be judged only by its importance in fundamental truth. The proper understanding of Nature and the discovery of the laws of Nature is a gift that is exceedingly rare, and it should be recognised wherever found, whether in the ranks of the professional men of science or in the ranks of the amateur scientist.

Research and discoveries, however, should not necessarily be expected of all teachers of science and other professional men of science; they both render great service to science in their profession, one by the teaching of it, the other by its practical application to modern improvements and the benefit to mankind. In the meantime, a few professional men of science can render unusually great service by making discoveries in fundamental truth.

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### The Planets Mercury and Venus.

THROUGH the kindness of Dr. Deslandres, I followed Mercury here last spring and summer with the 33-inch refractor, and all recent observations confirm my 1927 results with the same instrument as to the correctness of the 88-day rotation period and as to the presence of whitish atmospheric veils of low albedo, which occasionally distort and conceal the subjacent dusky areas. The axis of rotation of Mercury cannot of course coincide exactly with the perpendicular to the orbital plane, although it cannot form a considerable angle with it.

The experience gained by the use of the 33-inch refractor and the comparison of my data with those of many observers using all sizes of instruments, show that reduced diffraction in large telescopes not only broadens the dark interval between the components of double stars and Cassini's division in Saturn's ring, but that it also increases the size of all dusky planetary markings, such as the so-called seas and irregular streaks of Mars, or the belts and dark spots of Jupiter and Saturn. In the case of the minute disc of Mercury, the agency of diffraction, which causes luminous areas to encroach upon the small or narrow greyish spots, tends to bring about the extinction and invisibility of the latter. For this reason I cannot detect them with an aperture of 6 inches.

The discovery of the long rotation period of Mercury with a refractor of only  $8\frac{1}{2}$  inches by Schiaparelli must thus be considered as a wonderful feat

of observation, and this the more so as the appearance of the dusky markings of the planet is frequently modified by the interposition of the above-mentioned whitish veils, the existence of which did not elude the acuteness of the distinguished Italian astronomer.

I have also studied the planet Venus systematically with the large instrument, but the markings seen were of such a nature as to render impossible any conclusion concerning the period of rotation of the planet.

E. M. ANTONIADI.

Observatoire de Meudon (S.-et-O.),  
France, Oct. 16.

### Laboratory Drainage.

TROUBLE with laboratory drainage is so frequent that information on any new departure may be of general interest. It is difficult to obtain a material for waste systems which will withstand dilute acids, alkalis, organic liquids, and mercury, all of which find their way down chemical drains. So far, glazed ware pipes remain the best things for general use, but can only be obtained in very short lengths, involving an undesirable number of joints. I have tried to interest one or two firms in the production of moulded drains and channels of graded silica (sand) and asbestos bound together by high silica sodium silicate, but the demand does not appear to inspire much enthusiasm for research in this direction. Thanks to a professor in one of our universities, some alloys of nickel are under test in his laboratory drainage system, with a view to the possible use of this material.

A more recent departure is the use of vulcanite, and an enterprising firm has had made a vulcanite four-inch channel ten feet long which has been in use in another institution for three months, during which short period no change is discernible; but whether such a channel would withstand the severe conditions of some organic laboratories may be open to question.

Should any reader of *NATURE* be prepared to follow up this subject in the interests of advancing laboratory construction, I shall be glad if he will communicate with me.

ALAN E. MUNBY.

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Lincoln's Inn, W.C.

### Higher Hydrocarbons from Methane.

IN view of the publication by Fischer (*Brenn. Chem.*, 9, 309; 1928) of the results of his experiments on the thermal decomposition of methane, to which reference is made by Messrs. Stanley and Nash in a letter published in *NATURE* of Nov. 10, it seems desirable to place on record the fact that the production of commercial yields of benzene by the pyrolysis of methane, without a catalyst, was proved in the Fuel Technology laboratories of the University of Sheffield about two years ago. The work forms the basis of certain claims in English Patent No. 26719 of Oct. 8, 1927.

For reasons which will appear in a forthcoming publication, I believe the production of benzene during the decomposition of methane to be through ethylene, which is an early product of decomposition, and butadiene, which ethylene yields on heating. The formation of ethylene from methane can be expressed as follows:  $\text{CH}_3 \cdot \text{H} \rightarrow \text{:CH}_2 + \text{H} \cdot \text{H}$ , two of the 'residues'  $\text{:CH}_2$  postulated by Bone and Coward (*J. Chem. Soc.*, 93, 1197; 1908) combining to form ethylene.

R. V. WHEELER.

Department of Fuel Technology,  
University, Sheffield,  
Nov. 12.



### Infra-red Absorption Spectra of Ammonia, Phosphine, and Arsine.

IN the *Proceedings of the Royal Society* for August (vol. 120, pp. 128-210) will be found a series of communications from the Government Laboratory on the infra-red spectra of the three gases, ammonia, phosphine, and arsine, by Sir Robert Robertson and Dr. J. J. Fox.

In the first two papers of this series are described in some detail the apparatus and arrangement, as it was represented to the authors that it would be of interest to others working in this field to give an account of their technique. In the third paper are given numerical data at gas pressures of 1,  $\frac{1}{4}$ ,  $\frac{1}{8}$ , and  $\frac{1}{16}$  atm. for the position of the oscillation bands, and for the rotation-oscillation bands when they have been resolved, together with curves illustrating these. The fourth paper contains a discussion of the molecular structure of the three gases as deduced from their band spectra.

A Hilger No. 2 infra-red spectrometer with wave-length drum engraved for a rock-salt prism was used. Both to calibrate the engraving of the drum and to obtain the values of the markings for use with prisms of quartz (up to  $3\mu$ ) and of fluorite (from  $3\mu$  to  $8\mu$ ), these values were experimentally determined in terms of angles of rotation of the prism table. It is considered that when prisms of different materials are employed, engraving on the drum would have been more convenient if it had been in terms of angles. To obviate the effect of variations of air pressure on the thermopile, this was enclosed in a specially designed air-tight casing with rock-salt windows.

In work in the infra-red region, the importance of taking into account the high temperature coefficient of refractive index of rock-salt and also of fluorite has been insufficiently recognised. This temperature coefficient has been determined by Liebreich, and as Sir Robert Robertson and Dr. Fox have already directed attention to this subject in this journal (*NATURE*, June 4, 1927, p. 818) it is sufficient to say that not only was the temperature of the prism taken periodically throughout each experiment and allowance made for any deviation from a standard temperature of  $18^\circ\text{C}$ ., but also as a working basis Paschen's values for the refractive indices of rock-salt and fluorite were referred to the same standard temperature, tables for this conversion being given in the paper. Most published tables of refractive indices of rock-salt and fluorite have ignored the fact that Paschen's determinations were made at varying temperatures.

A galvanometer of very high sensitiveness was used for registering the energy falling upon the thermopile, and to overcome the effects of electromagnetic disturbances and mechanical vibrations on this instrument constituted some of the chief difficulties of this research. By suitable shielding with 'stalloy' and 'mu metal' the former disturbances were overcome, whilst the mechanical disturbances were nullified by a suspension system which rendered the galvanometer usable at all times, even in a neighbourhood affected by continuous heavy road traffic.

The gases, prepared in a pure state, were passed into one of two observation tubes fitted with rock-salt end-plates, the other tube remaining empty, and these tubes were brought by means of a rocker device alternately into the optical train of radiation from a Nernst filament to which the input of energy was accurately controlled. Observations were made of the energy as it passed first through the empty tube and then through the tube containing gas. This arrangement was preferred to the alternative method of employing one observation tube and exploring sections of the spectrum through this tube when it is alternately empty and filled with gas. In the compensating tube method it is essential that the ends of both tubes shall be in strictly accurate optical alignment.

In all three gases, ammonia, phosphine, and arsine, a main sequence of harmonic oscillation bands is disclosed, but while such a regular departure from true harmonic ratio as Kratzer found in the case of the harmonic oscillation bands of hydrogen chloride is not found in any one of the three individual gases, nearly constant ratios are obtained between each of the corresponding harmonic members of the several gases. The following table illustrates the degree of uniformity of these ratios in the case of the main sequence of oscillation bands:

Band.	Wave Number.			Ratio.	
	Ammonia.	Phosphine.	Arsine.	Phosphine/ Ammonia.	Arsine/ Phosphine.
I.	1630.9	1125.0	1005.4	0.689	0.893
II.	3335.6	2327.2	2121.9	0.697	0.911
III.	5083.9	3413.7	3091.2	0.672	0.905
IV.	6609.4	4560.0	4161.5	0.689	0.912
V.	8250.8	5608.5	5125.6	0.680	0.914
				Mean 0.685	Mean 0.907

The rate of oscillation thus depends upon the mass of the nucleus of the heavy atom of the molecule, and doubtless by assuming a suitable law of force the distance of the atoms from one another could be calculated. It affords also an argument for a similar structure for the molecules of the three gases.

In addition, each of the three gases was found to have a second sequence of harmonics, and phosphine and arsine a sequence peculiar to themselves. Further, there appeared in ammonia a band at  $10.55\mu$ , apparently without harmonics, and members of a series of what were considered to belong to one mode of rotation of the molecules of that gas.

The oscillation frequencies become slower in the order, from ammonia to phosphine and phosphine to arsine, and the wave-number differences in the rotation bands show that the molecules also rotate more and more slowly in the same order.

Consideration is given in the fourth paper to the bearing as regards constitution of the data displayed in the previous paper. The occurrence of harmonics in the oscillation bands has already been



mentioned, and this is considered in conjunction with the determination of the electric moment of the three gases and the temperature coefficient of their dielectric constants as determined by Watson on samples of the same gases.

Hund, from a consideration of the polarisation and laws of force in the case of the ammonia molecule, concluded that when the polarisation reached an equilibrium position, the four ions forming a tetrahedron with equal side faces, this figure was stable. That the ions are separating is shown by the presence of the oscillation bands, and one of the modes of vibration is that of the nitrogen atom against the plane of hydrogen atoms. Hund's condition would then be fulfilled and a tetrahedral structure required for the model. In the case of ammonia and of phosphine, Watson's values for the electric moment clearly support such a view, but in the case of arsine he gets a small value for this and for the temperature coefficient of its dielectric constant.

Absorption bands as strong as those of phosphine are found in the spectrum of arsine, and it is argued that the electric moment should not be reckoned as directly measured by the product of the distance of the heavy atom from the three hydrogen atoms and the charges on the ions, but that the effect of the electron shroud, greater in the case of the heaviest of the atoms

members of a harmonic series appear with the first two members of the sequence absent. The evidence as a whole from these considerations is much more in favour of a tetrahedral than of a coplanar configuration for the molecules of these gases.

While it is recognised that the existence of optically active forms of substituted ammonium

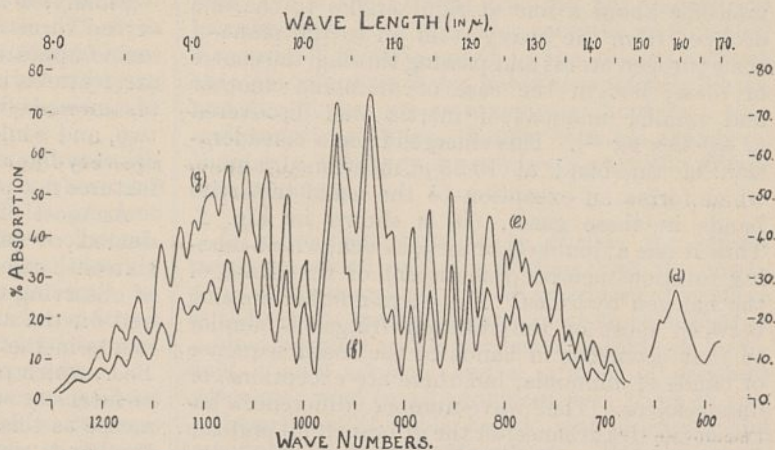


FIG. 2.—Band of ammonia at 10.55  $\mu$ . Upper curve at  $\frac{1}{4}$  atmosphere, lower curve at  $\frac{1}{2}$  atmosphere.

compounds is not decisive on this point, on account of the disturbance caused by the substituting groups, at the same time the work of Ellis and Salant on the infra-red spectrum of amino- and imino-compounds points to the N-H oscillation being connected with what is termed above the main sequence of harmonics, and this view does not conflict with the attribution of other degrees of freedom, some of which correspond to valency bonds, to the other series of oscillation bands in ammonia.

No oscillation bands have been found in these gases similar to that found (and resolved) by Imes and others for hydrogen chloride and characterised by what may be termed *P* and *R* branches, with a missing *Q* or central branch. As a rule, the oscillation bands of ammonia, phosphine, and arsine have *P* and *R* branches with a bold central *Q* branch of absorption. They are usually of the type shown in Fig. 1, which shows a band in which the *P* and *R* branches have been resolved to give the rotation fringes.

From the wave number differences, which vary little from band to band for each of the gases, the moment of inertia has been calculated from

$$J = \frac{nh}{4\pi^2\Delta\nu}, \text{ and } J \text{ has also been calculated from the}$$

classical energy relation  $\frac{1}{2}J(2\pi\nu)^2 = \frac{3}{2}kT$ ,  $\nu$  in this case being the mean difference between the peaks of the *Q* and the *P* and *R* branches. In the following table are given the results of these calculations:

	$J_1 \times 10^{40}$ from Band Structure.	$J_2 \times 10^{40}$ from Energy Relations.
Ammonia . . . .	2.78	3.49
Phosphine . . . .	4.78	6.24
Arsine . . . . .	5.53 or 6.51	8.28

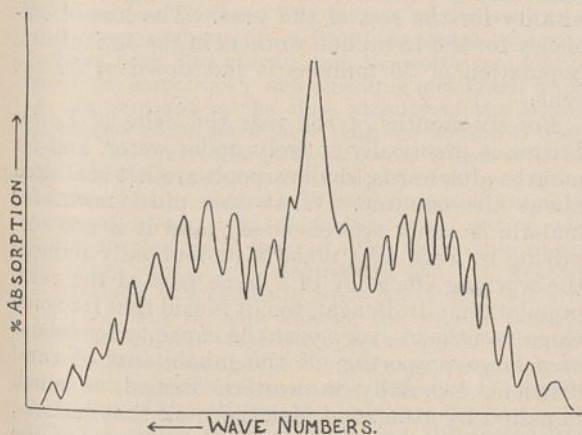


FIG. 1.—Typical band of ammonia, phosphine, or arsine.

(arsenic), comes into play, acting in the opposite direction to the original electric moment. Thus a tetrahedral structure is deduced for all three molecules, though not necessarily of equal height.

Since, in addition to the main sequence of harmonic oscillation bands mentioned above, there occur other sequences, some speculations are made, especially in the case of ammonia, as to the degrees of freedom of the atoms in that molecule of which these sequences may be the reflection. Thus arguments are adduced for assigning the oscillation that may give rise to the band at 10.55  $\mu$ , and for the peculiar sequence of bands of ammonia of which



The radius of gyration is also calculated from the former set of values of  $J$  and compared with those of Rankine, whose radius of mean collision area, as would naturally be expected, is greater than that of the radius of gyration.

The moments of inertia obtained above are thought to have reference to the rotation of the molecule about a line at right angles to the line dropped from the heavy atom on to the plane of the hydrogen atoms and passing through the centre of mass, but in the case of ammonia another and smaller moment of inertia was discovered ( $J = 0.35 \times 10^{-40}$ ). This emerged from a consideration of the band at  $10.55 \mu$  mentioned above, which forms an exception to the usual tripartite bands in these gases. It is shown in Fig. 2. Thus it has a double  $Q$  branch, cloven, with a missing rotation member reminiscent of the bands of the halogen hydrides. The wave-number spacing between most of the rotation fringes is similar to that occurring in bands of the main sequence of bands of ammonia, but there are exceptions, or disturbances. The wave-number difference between the disturbance on the  $R$  branch ( $g$ ) and the centre of the two  $Q$  branches ( $f$ ), thence to a disturbance on the  $P$  branch ( $e$ ), and thence to an isolated band beyond ( $d$ ), is 160 wave-numbers, this last band having a wave-number four times that of a so-called rotation band of ammonia

found by Rubens and Wartenberg about 160 wave-numbers ( $63 \mu$ ). It is therefore considered that there is here the imposition of another rotation system, and as its moment of inertia is much less, it is attributed to the rotation of the hydrogen atoms round a line dropped perpendicularly from the nitrogen on to the plane of the hydrogen atoms.

Finally, it may be said that while the structure of the three molecules, ammonia, phosphine, and arsine appears to be essentially similar, yet there are features in the infra-red absorption spectrum of ammonia which differ from those of the other two, and while the spectra of phosphine and arsine are very like one another, yet they themselves have features not possessed by ammonia.

As most of the work on these gases was conducted at pressures varying from one to one-sixteenth atmosphere, an opportunity was afforded of observing the effect of pressure on the intensity and on the area of the bands. In view of statements in the literature that such a law as that of Beer, which provides for an exponential decrement of intensity with pressure, does not hold for such a case as this, it was of interest to find that when the bands were well resolved this law was obeyed with remarkable accuracy. This would point to the absorption of the imposed radiation by a comparatively small fraction of the total number of molecules present in the gas.

### Health and Sanitation in India.

AN Appendix to the Report of the Royal Commission on Agriculture in India has recently been published,<sup>1</sup> consisting of a concise survey of conditions in each of the presidencies and provinces, eleven in all, of British India. One section of each such survey is devoted to public health and sanitation, and of these it is proposed to give a brief account. The Native States are not included in the survey.

The chief feature brought out by these sections of the volume is the tremendously heavy incidence of certain microbic diseases, such as malaria, cholera, and kala-azar, and the high mortality, or in the case of malaria, the severe deterioration in physical well-being and efficiency caused by them.

As regards malaria, the official figures of deaths directly due to this disease are undoubtedly far too high. Thus in the United Provinces about one million (out of a population of  $46\frac{1}{2}$  millions) are reported as dying every year of malaria; but "the village watchman [who is the registration authority] ascribes every case of death which he cannot understand to malaria"; still, the actual number of deaths cannot be less than 100,000 annually. The importance of malaria, however, lies rather (apart from the actual suffering) in the reduction of working efficiency, and in its being a predisposing cause of death from other diseases. Thus (again in the United Provinces) one-fourth of the total population get two attacks of malaria every year, and only

1 per cent receive proper quinine treatment; 25 per cent of the population are totally incapacitated for work for two months, besides having a lowered vitality for the rest of the year. The loss of efficiency for the 18 million workers in the agricultural population of 35 millions is put down at 50 per cent.

For six months of the year the delta of Lower Burma is practically entirely under water, and for months afterwards, shallow pools are left scattered about the country. What this must mean for malaria is easily apprehended; and it is not surprising to learn that malaria undoubtedly reduces the working efficiency of a large part of the rural population. In Bengal, too, it is said that for some three months in every year the capacity for labour of a large proportion of the inhabitants of rural districts, especially in western Bengal, is much impaired by attacks of malaria; and that malaria, in lowering the vitality of mothers, is one of the principal causes of the high rate of infant mortality from which Bengal suffers. Similar remarks are made regarding other provinces also.

Cholera is less widely distributed, and in most parts of India less constantly present than malaria. Bengal suffers more than any other province; the disease reappears year by year, and accounts on the average for rather more than 5 per cent of the total mortality. In the neighbouring province of Bihar and Orissa, the mortality rate from cholera is 2.2 per 1000, and the average mortality is nearly 90,000 annually (out of a population of 38 millions). Yet the disease is easily controllable, given a good

<sup>1</sup> "Royal Commission on Agriculture in India," Vol. 14. Appendix of the Report. Pp. vi+432+11 maps. (London: H.M. Stationery Office, 1928.)



water supply and the most ordinary sanitary precautions.

In Assam kala-azar is a special problem, and even takes precedence of malaria in importance; in the nineties of last century it took a terrible toll of life, leaving whole tracts deserted and uncultivated; the population of the district of Kamrup decreased during this period by 7 per cent, and that of Nowgong district by more than one-fourth. There is now an effective treatment; in 1925, 60,000 cases were treated, of which only 6365 died; twenty years ago, practically all the 60,000 would have been doomed to death.

Passing mention may be made of hookworm; in Madras, "in the wet districts, especially where rice cultivation is the main occupation, 80-100 per cent of the people are heavily infected with hookworm. This disease, though not immediately fatal, steadily undermines the physique of the population." In the eastern districts of the United Provinces, 86 per cent of the population are infected by hookworm. Plague we must pass over without comment.

The expectation of life in most provinces is about 21 years; in Madras, however, it rises to 26 years for males and 27½ for females; while in Burma, where the expectation is greatest, it is 31½ years for males and 32½ for females. A comparison with Great Britain may be made by saying that in the United Provinces the general death-rate is 2½ times as high as with us; this, of course, is largely due to the appalling infant mortality.

Along with the above facts must be considered the habits and conditions of life of the people. Of Madras it is said:

"Dwelling houses are badly constructed, devoid of light and ventilation. The houses of the very poor (and these unfortunately form the great majority) harbour both the human and the cattle population under the same roof; and cowdung and house refuse are accumulated in the close vicinity of the houses. In villages which have more than one source of water supply, no particular well or tank is reserved exclusively for drinking water, and pollution by washing, bathing, and by animal and human organic matter is universal. No system of drainage is in practice, with the result that pools form in every depression during the rainy season and stagnate in the hot weather. Of sanitary arrangements there are almost none, so that the soil in and around the village becomes polluted and all waterways are a positive danger. For medical assistance a villager may have to travel miles to the nearest dispensary, unless he is prepared to entrust himself to the administration of the 'quack.' Little wonder, then, that the deaths from preventable diseases reach appalling figures."

Most of this may be extended broadly to the whole of India; as most residents in India must have observed for themselves, the village pond serves for the village cattle to drink at and to wallow in, for young and old to bathe in, for washing the clothes of the village, for cleaning household vessels—and often for drinking also. In the general absence of any system of conservancy, the universal custom of the villagers is to go out in the early morning to relieve nature in the fields; in the larger villages and towns, the fields are not so easily reached.

Let me say, however, that it is unfair to bring a general charge of uncleanness against the Indian villager. The brass cooking-pots of the poorest Punjabi will invariably be kept polished and shining; the courtyards of their houses often look fit to dine off; their ablutions are, of course, far more frequent than those of a European workman; it is simply that they do not understand cleanliness in quite the same sense as an educated European. So it is noted in the present volume that the Burman is by habit scrupulously clean, and the houses are as a rule also kept in a tidy and orderly manner, though here (as elsewhere) there is a tendency to carelessness in the village surroundings.

It is scarcely possible to outline the official measures which exist for dealing with the conditions above described. In all provinces alike there is the regular medical service, with in each district a chief hospital and a number of subsidiary hospitals, a civil surgeon, and a number of assistant surgeons; and in all provinces, too, there is now a department of public health, with a director and a number of subordinate officers. But the organisation of the public health service varies too much from province to province to allow of any short or general description. A few points may be selected for comment.

The inadequacy of the public health staff is acknowledged in several provinces. Thus in Burma, though the department is said to have been very substantially strengthened, it still appears to consist only of the director with two assistant directors, and in most districts the civil surgeon combines the functions of health officer with his own proper duties; recently, 16 sub-assistant surgeons (officers of a lower grade than the assistant surgeons, who have not gone through the medical course for a degree) have been placed at the disposal of the department, "but this number must be very much increased if any impression is to be made on the province." In the Central Provinces, there are no district health officers, and want of funds is complained of; "there is a Village Sanitation Act which is applied to a few villages, and funds are collected and spent on cleaning village sites, wells, etc. But no schemes of an extensive nature can be carried out." In Assam, where it is said that, next to kala-azar, malaria is probably the most potent enemy to human life, *in a few localities* (italics are mine) special antimalarial measures such as the clearance of jungles and undergrowths, the improvement of drainage, and the treating of sheets of water with kerosene, are being carried out by Government and by tea companies. In Bihar and Orissa "it is not easy to get district boards to realize their responsibilities, and the percentage of the board's expenditure on sanitation to their total income shows no tendency to increase."

A serious fact is the shortage and high price of quinine. This drug is generally available at the post offices, where it is sold at or below cost price. In Bengal it is reported that the total amount so



sold is very small—from 0·7 to 2 grains per individual per annum in different parts, while on the scale of the Italian consumption 8 to 20 times, and on that of the Greek, 30 to 90 times, as much should be consumed. It must be added, however, that distribution of quinine is also carried out by local authorities, antimalarial societies, and other agencies, and the total amount so distributed is now somewhat greater than that purchased through the post offices. In the United Provinces it is said that the chief requirement for combating malaria is a very much larger quantity of quinine, available at a very much lower price; "in 1921, the total stock available for the whole of India was 160,000 lbs.; double this quantity would be required for the United Provinces alone." In Madras "people are well aware of the value of quinine as a specific against this disease, and were it available in sufficient quantity, and at a price within the means of the people, it would be widely used. But in present conditions the cost of any scheme of general distribution is prohibitive." The actual price charged, in Assam for example, is  $4\frac{1}{2}$  annas (about 5d.) for 80 grains; the amount of quinine required, according to modern ideas, for the adequate treatment of even a single attack of one member of a family makes a large hole in a monthly income of, say, 20-30 rupees.

The official agencies are in many provinces doing a large amount of propaganda work, and are endeavouring to instil into the people the elements of hygiene, and the knowledge of the causation of disease and of simple measures for its prevention. In Assam much work is done by the kala-azar staff among the public and in the schools by means of lantern lectures and the distribution of bulletins, pamphlets, and pictorial posters. In the Punjab the village schoolmaster has been enlisted for propaganda. In the Central Provinces lectures are given by health publicity officers. The institution of 'Baby Weeks' and 'Health Weeks' appears to have become very generally popular throughout the country; in Madras, for example, the 'weeks' are run according to a model programme drawn up by the Director of Public Health; "the movement has appealed to the general populace in an extraordinary manner, substantial evidence of which is forthcoming in the increasing volume of funds raised by private subscription."

Unofficial agencies are also responsible for much good work in certain provinces. Foremost come the antimalarial societies of Bengal, which began in 1917, and comprised at the end of 1926 some 300 registered and 700 'live' unregistered societies. These seek to awaken the villagers to the necessity and the possibility of improving the health of their villages by their own efforts; they believe in practical work, and undertake to kerosene ditches and tanks, excavate drains and track out malaria 'carriers' for remedial treatment. In Madras in 1927 numerous lectures were delivered, posters and leaflets were distributed, and in some cases lanterns and slides were provided; presumably the greater part of this activity was due to private enterprise.

The series of provincial surveys which we have been considering has an informative purpose only, and is not intended either to emphasise the seriousness of the conditions or to put forward plans for dealing with them. Speaking in the most general terms, which alone is possible here, measures for alleviation must proceed on three lines.

(a) The continued prosecution of research in preventive medicine—a matter which is more especially the charge of the Government of India and provincial governments. There is no doubt that the governments on the whole, and especially the Government of India, recognise their duties in this respect; the maintenance of the Central Research Institute at Kasauli as well as other more recent institutions, the establishment of the School of Tropical Medicine in Calcutta, the appointment of the kala-azar inquiry, etc., are sufficient evidence of this.

(b) The provision of larger funds for more adequate staffing of the public health departments of the several provinces, and for the carrying out of pure water, drainage, and other health schemes. But sanitation must take its place along with administration, justice, police, education, public works, etc.; and therefore the possibility of such a provision depends in the first place on the economic prosperity of the country; all measures that increase this prosperity—the improvement of agriculture, the provision of more adequate communications, etc.—tend also to increase the possibility of doing more for the public health.

(c) Lastly, the most important factor in the improvement of the public health must be the education of the people. The Indian people have now, through the elected members of the provincial councils, as well as through the district boards and municipalities, a considerable voice in the disposal of provincial and local funds; expenditure on sanitation may not at once produce spectacular results—a gradual diminution of the death-rate, even if it is apprehended, is not a matter that makes an immediate appeal—and may involve violence to age-old customs; money is therefore not likely to be voted for sanitation until the people have been taught to appreciate the benefits that adequate sanitation bestows.

Much, very much, can also be done by the people, even apart from expenditure of public funds, if, as is happening in many places, they can be induced—by lectures, lantern demonstrations, exhibitions, lessons in school, posters, pamphlets—to take an interest in health matters and act for themselves. Possibly more potent, though acting more slowly, than all else would be the penetration of the masses of India by a rational system of general education, which would alter the habit of mind of the whole population, and lead them to substitute for the ideas of chance and fate that of cause and effect, to think backwards from the facts of disease and debility to the conditions of which they are the natural and necessary consequence, and to exchange the insouciant attitude of to-day for a reasonable activity directed to shaping their own welfare.

J. STEPHENSON.



## News and Views.

PROF. GAETANA PONTE, the courageous Director of the Etna Observatory, describes the present eruption of Etna as being far more violent than the outbreaks of 1910, 1911, and 1923, all of which began to diminish in intensity after four or five days. The eruption began on Nov. 2 with a dense emission of ash-charged gas from the north-eastern slopes. Observation was difficult on account of mist, but it was noticed that lava began to flow copiously from three different places during that afternoon. The next morning lava broke through still more vigorously east of Mascali, and since then almost every day has seen the appearance of a new fissure. The torrent of lava that descended the Villonaccio valley quickly surrounded Mascali, and by Nov. 7 the little town was destroyed. In the valley to the north the lava has crossed the main railway line and reached the sea. A third flow in the valley to the south seriously threatens Carrabba and the larger town of Giarre. Here soldiers have been blasting out a depression to conduct the lava to the sea. On Nov. 8, Prof. Ponte flew over the great volcano and reported lava streams from several of the central craters. He predicted that the eruption would continue for at least another week. Since then a copious stream has started from a fissure five miles north-west of Mascali. Reports dated Nov. 12 stated that there had been a decrease in activity and it was hoped that the halt of the lava flow would be definite. Already a rich agricultural district of fertile gardens and orchards has been overwhelmed, and villages, bridges, roads, viaducts, cables, and water pipes have been destroyed. There has been little loss of life owing to efficient evacuation organisation, and already refugees are employed in making a new road from Giarre towards Annunziata.

THE secretariat of the Imperial Agricultural Research Conference, which held its inaugural meeting a year ago, has issued a second report detailing the action taken on the various recommendations which were then made. It appears that little headway has yet been made with the larger schemes proposed. The establishment of a chain of Empire research stations, the creation of new imperial bureaux and correspondence centres, the scheme for large-scale irrigation research, the training of biologists to meet the expected greatly increased demand, are either shelved for the present or are still under consideration. It is not proposed to create new research stations until the staff of the Amani Institute is brought up to full strength. The governing bodies of the institutions to which it is recommended that clearing houses of information should be attached have accepted the recommendations in principle, and the British Treasury has accepted the principle of a contribution towards the cost, but the other countries of the Empire have yet to nominate representatives to a body which is to discuss questions of organisation, cost, and their contributions. A discussion is proceeding with the Standing Committee of Vice-Chancellors of Universities, and the Headmasters' Association is being met, on the steps to be taken to increase the output

of biologists. Effect has been given, however, to several of the minor recommendations. It is disappointing to find that the manufacturing interests in Great Britain, which have been approached by the Ministry of Agriculture to provide scholarships for biological students and research workers, have not responded with any enthusiasm. It is equally disappointing to find such small indications of any enthusiasm of Overseas Governments of the Empire to undertake any financial responsibility for the encouragement of schemes of co-operative Empire research, although a year has elapsed since their formulation.

THE problem of water supply in great cities is one of growing importance, and not without anxiety for the future. Trustworthy statistics show that in the old type of house with water laid on but without hot water or bath, the daily consumption was seven gallons per head per day. In a modern cottage with bath and hot water, the daily consumption is fifteen gallons per head. With the view of adequate conservation and distribution of water supplies in the future, the Ministry of Health advises the appointment of regional water committees in Great Britain. A pamphlet under that title, issued by the Ministry, describes the work of such committees. They should be purely advisory and have no executive power. All the water boards and other water authorities whose interests are likely to be closely connected should be grouped in a committee with the view of discussing and reaching a common policy. Committees are advised to plan in detail for twenty years ahead, and in broad outline for fifty years. Periodical revision of projects will be necessary. Available supplies of water should be allocated to the best advantage of all areas in the region, and local supplies should not be overlooked in favour of upland sources. Reliable estimates of cost should always be obtained. It is hoped that those committees will be helpful in avoiding friction between rival claimants for water areas, and will reduce expense in the acquisition of satisfactory water supplies.

IN modern times mechanical advances produce their economic effect much more rapidly than was the case formerly. It took about forty years for a fairly complete network of railway systems to be established: twenty years for the roads of the country to be over-run and even congested by motor transport: and it will be a matter of a few years only from the full conquest of the air for air transport to become an important factor in our economic life. The railway companies have indicated that they are not to be caught napping a second time. The Air Council itself in its attempt to look ahead has now approached the local authorities with the view of enlisting their support to establish aerodromes in most of the towns. Inter-communication by air exists to-day between almost every large city on the Continent, particularly in Germany, and the encouragement to civil aviation afforded by municipal aerodromes is proving of great value. In a circular letter from the Air Ministry



to the local authorities in Great Britain, it is pointed out that in the absence of similar facilities, British industry cannot derive full advantage from air transport, and it is not possible for merchants to utilise aircraft, whether private or hired, for the speedy conveyance of material and documents either to Croydon, where they can connect with the cross Channel air service, or direct to their destinations abroad.

MUCH as the civil flying club movement has done to stimulate interest and foster enthusiasm in the air, progress is still hampered by lack of aerodromes and landing grounds. While provision for these facilities by the State must be confined to terminal points on 'trunk' routes, the establishment of a network of aerodromes, it is asserted, must devolve on the local authorities. Every town of any importance will sooner or later find it as essential to possess aerodromes as to possess stations, roads, and other facilities of transport. The Air Ministry is to be congratulated on this progressive step to foster a necessary development. The sooner local authorities become alive to the truth of the Air Ministry's contentions, the easier will it be for them to purchase land suitable for this purpose, before speculation renders the price prohibitive.

SEVERAL members of the staff of the Royal Botanic Gardens, Kew, have recently been studying problems of economic botany overseas. Mr. H. C. Sampson has just returned to Kew from his mission to British Honduras, which he paid at the request of the Governor of the Colony, with the approval of the Colonial Office and the Empire Marketing Board. His object was to study agricultural conditions in the colony and to offer advice as to future developments. The assistant director at Kew, Dr. T. F. Chipp, has just left to pay a visit to Cyprus and to the Sudan, at the request of the respective governments, to study botanical and agricultural problems, and he will be absent for about three months. This visit is being undertaken in connexion with the Empire Marketing Board's grant to Kew. A third visit, which should result in the acquisition of much valuable material both living and dried for the Herbarium, is being paid by Mr. J. Hutchinson. This also has been made possible by the Empire Marketing Board's grant to Kew. Mr. Hutchinson is making a careful study of the South African flora in conjunction with the South African botanists, which should be of great value to botanists in both places, as Kew possesses the old type specimens on which the "Flora Capensis" was written, but British botanists who have had to do with the flora have not seen the plants growing in their own home; while, on the other hand, very few of the botanists at the Cape have had the opportunity of seeing the types at Kew. The Director of the Royal Botanic Gardens, Dr. A. W. Hill, has just returned from delivering a short course of lectures at the Charles University, Prague, on the invitation of the University.

SIR GEORGE H. KENRICK has recently presented to the Natural History Department of the Birmingham Museum and Art Gallery his entire library of works

on entomology. The collections of insects in the Museum are of great importance and widely known, but no books relating to this particular branch of natural science have hitherto been available for consultation in the department. The gift comprises about five hundred volumes, including several early treatises, almost unobtainable nowadays, dealing with Lepidoptera found in every part of the world and containing hundreds of exquisite coloured plates. The collection also includes a number of popular books helpful to the beginner, as well as extensive series of reports and proceedings issued by various learned societies. A catalogue of the library is being prepared, and it is anticipated that the books will shortly be accessible, under proper conditions, to persons specially interested. For many years Sir George Kenrick has evinced keen interest in the progress of the Birmingham Natural History Museum. So early as the year 1912 he presented a collection of Midland Coleoptera, collected by the late Mr. W. G. Blatch. In 1915 he loaned, and afterwards presented, four handsome cases illustrating the evolution of the Lepidoptera, and so recently as 1927 he gave to the Museum his noted collection of foreign butterflies and moths, amounting to many thousands of specimens and arranged in eight mahogany cabinets. This collection, unfortunately, is not yet housed in the Museum owing to lack of adequate accommodation.

THE International Society of Experimental Phonetics, founded in connexion with the International Congress of Linguistics at the Hague in April of this year, has for its objects the promotion of research in phonetics. It is providing for the production of accurate apparatus for recording speech and measuring and analysing the speech curves. Arrangements for the publication of the work of its members are being made in England, Germany, and America. Its field of activity includes not only the linguistic side but also the physical study of speech with its relations to telephony, the psychology of speech, speech neurology, etc. Its governing board is at present constituted as follows: *President*, Prof. E. W. Scripture, Strudelhofgasse 4, Vienna, Austria; *Vice-President*, Dr. E. A. Meyer, Stockholm; *Honorary Members*, Prof. A. Meillet, Paris, and Prof. H. Zwaardemaker, Utrecht; *Regional Representatives*, Dr. A. Abas, Amsterdam; Dr. A. Äimä, Helsingfors; Prof. J. L. Barker, Salt Lake City; Prof. T. Benni, Warsaw; Prof. V. A. Bogoroditskij, Kasan; Dr. T. Dunajewski, Charkow; Prof. M. Grammont, Montpellier; Prof. C. A. Grandgent, Cambridge, Mass.; Prof. A. Gregoire, Liège; Prof. L. Grootaers, Louvain; Prof. P. Menzerath, Bonn; Prof. M. Metfessel, Iowa City; Mr. Marshall Montgomery, Oxford; Prof. I. Popovici, Cluj; Prof. A. Rosetti, Bucharest; Prof. L. Ščerba, Leningrad; Prof. E. W. Selmer, Oslo; Prof. T. Navarro Tomás, Madrid. The membership fee is 5s. (8½ Austrian Schilling). Applications for membership are received by the president or any regional representative.

A PAPER on "Field Archaeology as a Profession," by Sir Frederic Kenyon, in the November issue of the *Nineteenth Century and After*, is in effect a timely



survey of present conditions in archaeological research which incidentally raises a number of questions of wider bearing than its title suggests. To a certain type of man, or woman, as Sir Frederic points out, the life of a field archaeologist has many attractions to offer; but it cannot be said that the supply of really suitable candidates is adequate. Still more is this true in anthropology, where the need of field work is as great, if not greater, but the opportunities are more limited than they are in archaeology. The number of students in our universities who take up social anthropology, apart from government officials, either prospective, on leave, or specially seconded, and missionaries, is disappointingly small. Academic authorities, when confronted with the dearth of suitable men in both branches of investigation, are, however, not without justification for their reply that, given the posts suitable, men will be found and trained to fill them. So far as archaeology is concerned, Sir Frederic Kenyon is able to point to the fields of investigation which have been opened up or extended since the War, some partly or entirely under our own jurisdiction, such as Iraq, Palestine, Cyprus, Honduras, India, and so on; others which are available through co-operation with other countries, such as Greece. Sir Frederic points out that the great excavators who have made modern archaeological history, have attained the rank of veterans and a younger generation must take their place. Even so, in present conditions, the number which can be absorbed is limited, not because the field is restricted, but because the funds required to carry out the work on a scale which would make archaeology really a profession which would attract are not forthcoming. The same argument applies even more strongly to social anthropology and ethnology. In all branches of the study of man a fund which will provide an assured basis for the systematic prosecution of research in the field is the first and most urgent requisite.

At a joint meeting of the Scottish sections of the Society of Chemical Industry, Institute of Chemistry, and Society of Dyers and Colourists, held in Glasgow on Oct. 19, Dr. H. H. Hodgson, head of the Chemical Department, Technical College, Huddersfield, surveyed recent utterances at public conferences during 1928 from the points of view of the chemist and teacher. "Science and Craftsmanship," by Sir William Bragg, received primary attention. In consequence of the revolution in industry now in progress and the ever-increasing dependence of industry on process and ever-diminishing reliance on manual skill, the importance of humanistic non-vocational studies in our national scheme of education was stressed, since in a democratic age when great issues are decided by a majority vote the necessity for all sections of the population to meet on common ground somewhere becomes self-evident. The work of research associations justifies Sir William Bragg's opinion that "much of our hope for the future is built upon their work." The position of the chemist in industry was considered and a rapid survey made of large-scale operations which have little or no laboratory equivalent; above all, the importance of a knowledge of

costing was emphasised. Lord Melchett's valuable presidential address to the Association of Technical Associations was recommended for reading as a great stimulant for the science teacher; it is difficult to overrate the national importance of contentment in employment brought about by a proper realisation of the underlying interest in all scientific operations. Teachers of experimental science, however, should have research experience, only such men being capable of inspiring pupils both by precept and example.

THE Institute of Physics has arranged a scheme by which any corporate member who wishes to borrow an instrument for research or demonstration purposes may do so from one of the 37 firms of instrument makers who are participating in the scheme. The charge will be £1, 1s., plus 10 per cent of the price of the instrument for the first fortnight, and 5 per cent for each subsequent week. If the loan is continued for 20 weeks, the instrument becomes the borrower's own. The borrower pays carriage both ways, and is responsible for any damage to the instrument in transit or in use, fair wear and tear excepted. Applications for loans should be made to the Institute. The Institute has also announced a further privilege of membership by which, commencing in January 1929, fellows will receive the *Journal of Scientific Instruments* free of charge, and associates receive it at a small charge. The *Journal* is produced by the Institute with the co-operation of the National Physical Laboratory. It was established in 1923, and is now in its fifth volume. The consistently high standard of contributions which has been maintained is reflected in the increasing circulation and improved position which has enabled this scheme of distribution to be undertaken.

A MOVEMENT is on foot for the creation of a Twickenham Museum, to be housed in York House, and to be under the ægis of the local town council. As reported in the *Thames Valley Times* of Oct. 17, a public meeting agreed with enthusiasm to the formation of a museum, and a committee, of which the Mayor-elect, Councillor C. Carus Wilson, was appointed chairman, was elected. The speeches made at the meeting suggest that somewhat vague ideas of the functions of a local museum were entertained by some of the audience, and the statement that amongst the gifts accepted were "spear-heads many feet long" suggests that this museum at its outset may be in danger of encouraging the collection of the world-wide odds-and-ends which have proved the bane of so many local museums. The formation of a local committee, however, should now enable a definite policy of development to be formulated, and no better guide to such a policy could be found than Sir Henry Miers' report to the Carnegie United Kingdom Trustees.

THE University of Liverpool continues to be a growing and active centre of tidal research and computation through the work of Drs. Proudman and Doodson, Director and Secretary of the Tidal Institute (University of Liverpool. Tidal Institute, Ninth Annual Report, 1928). Besides the publication of theoretical researches, analyses of tidal observations for seven



ports have been made, for the Admiralty, Australia, and the Crown Agents for the Colonies; predictions have been prepared for fifty-one ports. A special feature of the year's work was the investigation of the circumstances that resulted in the disastrous Thames floods of Jan. 6-7, 1928. Dr. Doodson made a detailed study of the variations of sea-level all round the North Sea for intervals including four great storms, and it is stated that some remarkable sequences were revealed. He has also further developed the methods of analysing tidal observations, and a short account of some of his methods is included in the "Instructions for Analysing Tidal Observations," published as a small pamphlet by the Hydrographic Department of the Admiralty (price 9d. net).

M. HENRI BERGSON, the distinguished French philosopher whose name is associated with the theory of creative evolution, has been awarded the Nobel prize for literature for 1927. The Nobel prizes for chemistry for 1927 and 1928 have been awarded to Prof. H. Wieland of Munich, for his work on gall acids, and to Prof. A. Windaus of Göttingen, for his work on the stearines and their relation to vitamins, respectively.

DR. H. DESLANDRES, director of the Paris Observatories at Meudon, has been elected an honorary member of the American Astronomical Society. Only one such election annually is permitted by the constitution of the Society, and there are only seven other living honorary members.

THE following have been elected officers for the session 1928-29 of the Philosophical Society of the University of Durham: *President*, Sir Charles A. Parsons; *Vice-Presidents*, Dr. G. R. Clemo, Mr. Wilfred Hall, Mr. H. J. Hutchens, Dr. J. Irvine Masson, Sir Theodore Morison, Dr. John Morrow; *Hon. General Secretary*, Dr. D. A. Allan; *Hon. Treasurer*, Mr. J. W. Bullerwell.

THE annual general meeting of the Mineralogical Society was held on Nov. 6, and the following officers were elected: *President*, Dr. G. T. Prior; *Vice-Presidents*, Sir J. S. Flett and Dr. J. W. Evans; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith (Natural History Museum, South Kensington, S.W.7); *Foreign Secretary*, Dr. J. W. Evans; *Editor*, Dr. L. J. Spencer.

AT the annual general meeting of the Cambridge Philosophical Society, held on Oct. 29, the following were elected officers of the Society for the ensuing session: *President*, Mr. G. U. Yule; *Vice-Presidents*, Prof. G. I. Taylor, Dr. H. Lamb, Prof. S. J. Hickson; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Mr. F. T. Brooks, Dr. D. R. Hartree; *New Members of the Council*, Prof. A. Hutchinson, Mr. R. H. Fowler, Mr. J. T. Saunders, Mr. S. W. P. Steen.

THE following officers and new members of council of the London Mathematical Society were elected at the annual general meeting held on Nov. 8: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Mr. R. H. Fowler, Prof. E. H. Neville, Mr. E. C. Titchmarsh; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H.

Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*, Prof. O. Veblen, Mr. T. L. Wren.

"THE Culture Value of Natural History" is the title of the fourth annual Norman Lockyer Lecture, to be given under the auspices of the British Science Guild by Prof. J. Arthur Thomson, Regius professor of natural history in the University of Aberdeen, on Wednesday, Nov. 28, at 4.30 p.m. in the Goldsmiths' Hall, Foster Lane, E.C.2 (by permission of the Goldsmiths' Company). A few tickets for the lecture are still available and are obtainable on application to the Secretary, British Science Guild, 6 John Street, Adelphi, London, W.C.2.

By the exploitation of her own resources and the skilful adaptation of Western ideas, Japan has, during the past half-century, left medievalism behind and become a world power of first-class importance. The extent of her development of research in the physical sciences alone was indicated in an article which appeared in our issue of Mar. 12, 1927, p. 407. The recent enthronement at Kyoto of the young Emperor of Japan has therefore been made the occasion for many tributes and congratulations, both official and unofficial, with which we are sure that scientific workers in particular will wish to be associated. In this connexion Sir Robert Hadfield, who is himself a member of the Japanese Order of the Sacred Treasure, has contributed an appreciative message to the *Japan Advertiser*, in which he refers to his own visit to Japan and to his meetings with Japanese leaders, including the present Emperor before his accession to the throne, when on visits to Great Britain.

A MONTHLY magazine for young people, entitled *Friendship* (price 6d.), is published at Ramhurst Manor, Tonbridge. It aims at fostering friendship between the youth of all nations by means of actual travel and a better understanding of the characteristics of various peoples. Each number is devoted to one or more countries in pictures and articles descriptive of national life, traditions, customs, and scenery. The October number treats of Norway, Sweden, and Denmark. The articles are short and interesting, and well illustrated by wood blocks. There is also a large pictorial map of Scandinavia. This kind of map is entertaining and likely to interest children, even if it lacks something in accuracy. There are other features of interest in the magazine, and the whole has a strong savour of the sea.

THE September issue (No. 15) of *Watson's Microscope Record* contains matter that will be of interest to most microscopists. Beginners will find help in Mr. Merlin's article, which deals with the choice of instrument and the importance of tube-length, or if they are taking up photomicrography, in the instructions given for developing the negative. The Rev. Dingley Fuge discusses the structure of a common diatom, Mr. Brown tells us how properly to display the blow-fly's tongue, and Mr. Gray gives some useful hints on mounting-media and on mounting insect parts. In lighter vein is "A Message from Mars"—a fable, and Mr. Offord's



reminiscences of fifty years ago, including his first attendance at the Quekett Club with Huxley as president. 'Notes and Queries' and descriptions of apparatus and instruments complete an interesting number, which may be obtained from Messrs. Watson and Sons, 313 High Holborn, London, W.C.1.

MESSRS. Bowes and Bowes, Cambridge, have just circulated a useful catalogue (No. 444) of second-hand works—1000 in number—ranging over the following branches of science: Scientific biography and travel; agriculture, with gardening and forestry; anthropology and ethnology; chemistry and physics; geology and mineralogy; biology (general), including microscopy; botany; zoology (general); marine and fresh water zoology; entomology; ornithology, and miscellaneous science. The catalogue can be had upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An experimental biologist at the Middlesex Hospital Medical School, for radiological research bearing on the therapy of malignant disease—The Dean of the Medical School, Middlesex Hospital, W.1 (Nov. 26). A lecturer in civil engineering at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 27). A professor of dental surgery and pathology and superintendent of studies in the Dental School, Cairo—the Dean of the Faculty of Medicine, Egyptian

University, Cairo (Nov. 28). A special librarian for the Institute of Metals—The Secretary, Institute of Metals, 13 Members' Mansions, Victoria Street, S.W.1 (Nov. 29). A professor of materia medica and therapeutics at the Royal Veterinary College—The Secretary, Royal Veterinary College, Camden Town, N.W.1 (Nov. 30). A lecturer in biology and chemistry in the chemistry and dyeing department of the Leicester College of Technology—The Registrar, College of Technology, Leicester (Nov. 30). A lecturer in applied mathematics in the Faculty of Science of the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Dec. 1). A lecturer in physiology in the University of Birmingham—The Secretary, The University, Birmingham (Dec. 3). A physiological botanist for research work on cotton to be carried out at Coimbatore under the Development Department of the Government of Madras—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 14). A secretary of the Education Committee of the League of Nations Union—The Secretary, League of Nations Union, 15 Grosvenor Crescent, S.W.1. An assistant to the surveyor of the School of Agriculture Estate Management Branch, University of Cambridge—The Estate Management Branch, School of Agriculture, Cambridge. A lecturer in agricultural biology at the Seale Hayne Agricultural College—The Principal, Seale Hayne Agricultural College, Seale Hayne, Newton Abbot.

### Our Astronomical Column.

A RECENT SUNSPOT.—A large group, typically 'bipolar' in appearance, has recently been under observation. The group was conspicuous on account of the size and regularity of the leader spot, which exceeded 700 millionths of the sun's hemisphere. There was a cluster of spots forming the other extremity of the group  $15^\circ$  of longitude behind the big spot. On Nov. 4, when the group was near the east limb, Mr. Newbegin noticed a bright reversal of the C-line of hydrogen in the preceding part of the umbra of the leader spot, and he also detected dark filaments between it and the cluster of spots in the rear. These latter spots seemed to be associated with a metallic prominence seen at the east limb on Nov. 3. No associated magnetic disturbance was recorded about the time of central meridian passage of the group on Nov. 9, further particulars of which are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
10	Nov. 2-15	Nov. 9.4	$16^\circ$ S.	1/1100 of hemisphere.

THE ECLIPSE OF MAY 9, 1929.—*Astr. Nach.*, No. 5589, contains an article by Mr. F. J. M. Stratton on this eclipse, which is the third in the present century in which Sumatra enjoys totality; the others were in 1901 and 1926. On this occasion Siam and the Philippine Islands are also available as stations. The Greenwich and Cambridge party will occupy Alor Sta in Kedah, and Pattani in Siam. The investigation of the Einstein displacement of stars near the sun will be made at both stations; the Greenwich astrographic equatorial will be mounted at Pattani and a celostat at Alor Sta. The spectrum of the chromosphere and corona will be studied, also polarisation and rotation of the corona.

There will be numerous other parties. German expeditions will be sent from Potsdam, Kiel, Hamburg, and Göttingen. Italian and French expeditions, and two or three American ones, will also be observing the eclipse. The line of stations to be occupied is so long that there is very good prospect that at least some of the parties will have favourable weather conditions.

THE INDEBTEDNESS OF GREEK ASTRONOMY TO BABYLON.—The *Observatory* for October publishes a lecture on this subject, delivered last February by Dr. J. K. Fotheringham. It has been made clear in the present century that much of the knowledge of the motion of the sun and moon that had been supposed to have been deduced by the Greeks from their own observations was derived from Babylonian astronomers, in particular Naburiannu and Kidinnu. To them was due the determination of the length of the synodic month which Ptolemy attributed to Hipparchus. One important discovery still seems to be Hipparchus's own, that is, the precession of the equinoxes. The Babylonians seem to have noticed some anomalies in longitude, but not to have traced them to a motion of the equinox. Dr. Fotheringham is able to fix the year 383 B.C. as that of the adoption of some of Kidinnu's values, and the beginning of the use of the 19-year lunar cycle. Naburiannu's date is about 500 B.C. The extraordinary fact is brought out that Kidinnu's value for the motion of the sun from the node was nearer the truth than that used by Oppolzer in his Canon of Eclipses more than two thousand years later. Kidinnu's value was based on the Babylonian observations of eclipses for the preceding 360 years. His good result is a testimony to the quality of these observations.



## Research Items.

**AMERICAN INDIAN MUSIC.**—Miss Frances Densmore, the well-known student of the music of the American Indian, and author of a number of monographs on the music of specific tribes, has published in the *Journal of the Washington Academy of Sciences*, Vol. 18, No. 14, a study of the general characteristics of Indian music based upon more than 1700 songs which she has collected since she began work in 1893. With the American Indian, music is not an art in our sense of the term, but primarily a means by which he believes that he can put himself in communication with the mysterious forces of the earth, sea, and air, to which he looks with awe and reverence in his daily life. It was therefore used primarily in the working of magic and the treatment of the sick. Nor was it based originally on the tones produced by an instrument. Only the correct version of a song is recognised by the Indian. It must be repeated absolutely accurately. A repetition has been found not to vary in tempo, pitch, and note values after an interval of two years. The analysed songs do not suggest a resemblance to the songs of Asiatic or European countries, though the Indians themselves recognise two classes of songs. The second class shows what appears to be Spanish, Roman Catholic, or Russian Church influence. Collective analysis shows a perception of simple ratios of vibration, but these tones are frequently used in what may be termed an interval-formation of melody, which does not suggest a keynote, and has no counterpart in our musical usage.

**FIRE-MAKING.**—Mr. Walter Hough has written a description, very fully illustrated, of the fire-making apparatus in the United States National Museum, which is published in Vol. 73, Art. 14 of the *Proceedings*. These appliances, that is, those of primitive type and leaving aside lens, mirror, matches, and other modern methods, fall into five main categories, each with well-marked distribution. The first is on wood by reciprocating motion. Of these, the two-part method, in which fire is produced by friction of two pieces of wood of varying form, has the widest distribution, being found among the Indians of North, Central, and South America, Australians, Japanese, Africans, etc. The four-part apparatus, mouth drill and two-hand drill, is found among the Eskimo, some Indians, in Siberia, among Hindus, and among the Dyaks. The compound weighted drill occurs among the Chuchis and the Iroquois. The sawing motion, the second main division, in which knife and thong are used, occurs among the Malays and Burmese. The third division, still on wood, is that of the ploughing or planing motion, which is found among the Polynesians and some of the Australian tribes. The fourth method, of percussion, is used with minerals, and is that to which the flint and steel belong. Pyrites, or stones containing iron, and flint, are in use among the Eskimo and Indians of the north of North America of the Algonkian and Athapaskan stocks, while flint or other hard substance is used to strike sparks from the bamboo by the Malay. Pictorial data in the manuscripts show that the ancient Mexicans used the simple fire drill, and its use is still continued among the uncivilised tribes of the mountains in Mexico. The simplest and rudest fire-making appliance in the collection is that which comes from Costa Rica, the hearth being a rude billet or charred block of wood and the drill a branch rudely trimmed with a knife. It is said that the Apache is the most skilled fire-maker in the world. Many tribes can produce fire in less than a minute. The Apache can make it with a fire-stick in less than eight seconds.

**HUMAN TEETH AS RACE INDICATORS.**—The arrangement of the cusps accompanied by a definite system of grooves in the lower molar teeth of man appear to have distinct evolutionary significance. The fundamental pattern is markedly primitive and has been termed by W. K. Gregory the "Dryopithecus pattern." It is now shown by Milo Hellmann (*Proc. Amer. Philos. Soc.*, vol. 67, No. 2) that in man the pattern is undergoing a gradual and progressive change, which can be recognised by certain well-defined stages, marked by modification in the furrows or by a reduction in the number of the main cusps, or by both. The most advanced stage in this series consists of four cusps and a cruciform groove in place of the five cusps and Y-shaped groove of the most primitive pattern. This highest stage of reduction is characteristic of modern white races, and it would appear that American children are more advanced than ancient and modern Europeans. The most primitive stage is retained by the natives of West Africa, and intermediate forms are possessed by the Mongols. The paper is in the nature of a general survey, and more detailed accounts are promised on the completion of further investigations.

**SYMPATHETIC NERVOUS SYSTEM OF LEPIDOSIREN.**—Miss P. M. Jenkin (*Proc. R. Soc. Edin.*, vol. 48, pt. 1, No. 7; 1928) has made an investigation of the sympathetic nervous system in *Lepidosiren*, hitherto undescribed, and finds it to consist of a single delicate main cord of nervous tissue running each side of the dorsal aorta, and containing ganglion cells, either singly or in groups, but in no case forming visible swellings of the cord. At the anterior end the cords join a branch of the first spinal nerve, but do not reach the vagus ganglion. Rami communicantes are present in the trunk region, one from each spinal nerve, but are absent from the caudal region. Medullated nerve fibres are absent, and there is no collateral system. Comparing the sympathetic system in *Lepidosiren* with that of other lower vertebrates, the author concludes that it most nearly resembles the Salamandrine type, and is, in fact, intermediate between that type and the Ichthyodian type as described by Anderson. It is simpler than the latter type in lacking both cranial and collateral portions and a prevertebral plexus. The sympathetic system of *Lepidosiren* is extremely delicate, and associated, as is usual in such cases, with a strongly developed vagus.

**THE CONTRACTILE VACUOLE.**—The attention of physiologists and biologists is directed to the current issue of *Biological Reviews* (vol. 3, No. 4, Oct. 1928), which contains admirable summaries of the present state of knowledge on tissue culture from the point of view of general physiology, by Mr. E. N. Willmer, on anaerobic life in animals, by Dr. W. K. Slater, and on the contractile vacuole—its structure, behaviour, and function—by Prof. Francis E. Lloyd. It is impossible to summarise these reviews, but a few points from the last may be noted here. Prof. Lloyd remarks that in all known cases the contractile vacuole is correlated with either the absence or non-rigidity of the cell wall or with displacement of the protoplast therefrom. He has recently been examining marine protozoa and has found a number of species in which the contractile vacuole occurs, though it is usually stated that the contractile vacuole is generally absent in marine protozoa. During the very early phase of systole of the contractile vacuole of *Paramecium* there is a reflux of fluid from the vacuole into the radial canals,



and systole of the canals is synchronous with the early period of diastole of the contractile vacuole. Prof. Lloyd has carefully studied the contractile vacuole in the gametes of *Spirogyra*, and is convinced that vacuoles may be repeatedly formed in the same position exactly and burst repeatedly in the same point on the surface. The function of the contractile vacuoles of *Spirogyra* is unequivocally to rid the gametes of water, leading to their condensation to the volume of the definitive zygote. While it would be tempting to generalise that the function of the contractile vacuoles is to get rid of water in those forms which have not the support of a membrane of sufficient rigidity to resist the osmotic pressure of the protoplast, the author thinks this might be going too far.

EXPLORATORY VOYAGES FOR HAKE.—The Fleetwood exploratory voyages for hake (C. F. Hickling, *Jour. du Conseil Perm. Int. pour l'Exploration de la Mer*, vol. 3, No. 1, April 1928) were made in an endeavour to extend the commercial trawling grounds, particularly into deeper water. The Faroe-Shetland channel proved exceedingly poor in all kinds of fish, but farther south, on the western slope of the Wyville Thomson Ridge, good catches were obtained. Mr. Hickling made observations on the numbers of hake caught per hour, and showed that the optimum depth in the areas investigated was between 260 and 300 fathoms; down to 380 fathoms a fair quantity was obtained, after which the fish disappeared. Data are also given of the temperatures in which the hauls were taken, but it is not clear whether the optimum temperature, which was different in different regions, is merely a reflection of the optimum depth or not. Attention is directed to the importance of the blue whiting (*Gadus Poutassou*) as hake food on the north-western fishing grounds in 1927; possibly the high catches on the Wyville Thomson Ridge were due to a transitory abundance of this fish.

RESEARCHES ON THE HOLOTHURIAN CAUDINA.—In his paper "On the Changes occurring with Advancing Age in the Calcareous Deposits of *Caudina chilensis* (J. Müller)" (*Science Reports*, Tôhoku Imperial University, Fourth Series (Biology), Sendai, Japan, vol. 3, No. 3, fasc. 2, May 1928) Mr. Sanji Hôza shows that there is a gradual change in the spicules with the growth of the body. He divides the individuals into four stages, each stage showing an advance in the organisation of the calcareous deposits. Thus Stage 1 consists of very young animals having these deposits only in the integument, anal projections, calcareous ring and madreporic body, Stage 2 having them also in the membrane investing the inner base of the tentacle crown, Stage 3 in addition having them in the radial longitudinal muscles of the body wall and in the stone canal, whilst Stage 4 has them also in the circular muscles of the body wall. The size of the calcareous ring is important in determination of age, as it is apparently strictly proportional to the growth of the animal. Corresponding with these stages there may be changes in form, size, and quantity of the spicules. The main spicules are rings enclosing a cross on the outer surface and a square on the inner, the number increasing with age and each spicule becoming more irregular in shape. The calcareous ring also changes considerably in shape and size. Mr. Lieh Tao, in "Preliminary Observations on the Chemical Effects upon the Lengthening of *Caudina Muscle*," dealing with the same organism in continuation of his previous work (Part 2, 1927, of this Report), studies the behaviour of the ventral longitudinal muscle in various solutions, these smooth muscles being apparently more sensitive to the effect of salts than are striated muscle and the smooth muscles of vertebrates.

A DISEASE OF THE BASKET WILLOW.—R. M. Nattrass describes a disease of the basket willow in the *Transactions of the British Mycological Society*, vol. 13, parts 3 and 4, Oct. 1928. The causal organism is thought to be *Phyalospora Miyabeana* Fukushi. The fungus produces a 'black canker' upon the rods, but has hitherto been regarded as a wound parasite only, but Nattrass shows that it may penetrate the cuticle of the young leaf or stem and thus produce considerable damage upon certain varieties of willow under cultivation in the west of England. The primary attacks are confined to the young shoots, but when young rods, six or eight inches long, are attacked, the fungus may work down the entire length of the shoot and enter the parent stool. Spraying with Bordeaux mixture is suggested as a method of control, and field trials are in progress to test the suggestion.

METHODS OF TRANSPORTING TREES AND SHRUBS.—Jas. A. Neilson, of the Department of Agriculture, Port Hope, Ontario, Canada, has a note in the *Gardener's Chronicle* for Oct. 27, which suggests the trial of a new method where scions, after removal from the parent plant, have to be kept some time and possibly transhipped, before they can be grafted upon the stock. Such scions are very apt to dry out, and their maintenance in moist sawdust during long periods has many disadvantages. Neilson has tried instead the effect of coating the shoots with hot paraffin wax. Walnut scions thus treated were transported from Canada to England; whilst fruit and nut trees, after similar treatment, were sent from Poland to Canada and afterwards held in storage for some time before grafting. The results seem to have been very successful, and Neilson also suggests this method for the stems and twigs of woody shrubs and trees that have to be held in storage for some time before planting. The wax is apparently applied with a brush whilst hot. The treatment is therefore a simple and inexpensive one, and commends itself as antiseptic in tendency. It should at least be worth a more extensive trial.

IRRIGATION SURVEYS IN INDIA.—The practice of rectangulation in irrigation surveys is widely followed in the Punjab and elsewhere. The main rectangles are divided into small rectangles, and levels are shown at all the corners. On such a network superimposed on the topographical map it is possible to lay out with accuracy a system of watercourses and canals. An account of the methods of rectangulation and a discussion of the value of the system is published by the Survey of India in *Professional Paper No. 21* (Irrigation and Settlement Surveys, 1926, price 2s. 6d.). The corners of main rectangles are usually fixed by traversing, since the closing of the traverse is an immediate check on the accuracy of the work. In very open ground or low hills, triangulation is sometimes used. The rectangles are marked on the ground by corner stones. The main rectangles are made as long as possible and generally are about 3 miles by 2 miles. They must be capable of subdivision into rectangles of the dimensions required by the Revenue Department which would appear to be 25 acres, with sides of 1100 yd. and 990 yd. The paper includes several sheets of rectangulation survey.

TECTONICS OF THE GREAT RIFT VALLEY.—As a result of travel in Uganda and Tanganyika and detailed geological work in Kenya, Dr. E. Parsons has reached some definite conclusions with regard to the origin of the Great Rift Valley, which, with the evidence on which they are based, are recorded in the *Trans. Geol. Soc. S. Africa*, pp. 63-96; 1928. He shows that the earth movements that have affected the strata of the coastal region of Kenya



were a result of compressional stresses rather than tensional, that is to say, that they were due to crustal pressures such as in other regions have resulted in the formation of folded mountain structures. The latter, however, have been produced in heavily sedimented areas containing long stretches of relatively unconsolidated deposits. In Africa these were not present, but, on the contrary, the region consisted largely of crystalline and thoroughly consolidated rocks, which had long underlain a stable land area. Consequently, according to Dr. Parsons, instead of folding, the rocks fractured along reversed faults which, with the subsequent vulcanicity and denudation, have given rise to the unique land-forms seen along the Rift Valleys. Several advantages are claimed for this view, but no explanation is afforded of the highly characteristic double-sided character of most of the rifts; nor is the hypothesis brought into harmony with the implications of isostasy.

**THE ELECTRIC MICROMETER.**—The increasing use of very large steam turbines has made it necessary to improve the methods of testing their 'balance' in order to avoid the large unbalanced forces which are sometimes called into play when they are running. When there is a good balance, the radial motion of the rotating part of the steam turbine is only at the most a few thousandths of an inch. In order to test the running of the machines, the General Electric Company of America makes an electric micrometer which has been successfully used to measure the vibrations of rotating shafts when the amplitude of the vibration is as small as the ten-thousandth of an inch. A description of the instrument and of some of its applications is given in the *General Electric Review* for October. A special oscillograph is used, the vibrations of which depend on the amplitude of an air-gap which varies with the vibrations that have to be measured. When obtaining a measure of the mechanical vibrations, the air-gap is calibrated to thousandths of an inch, and when recording transient pressures it reads in pounds per square inch. Variations of the pressure of the water in a 24,000 kilowatt water turbine are shown. Thirty electrical periods correspond to one revolution of the turbine runner. By plotting curves from the oscillograms it was found that the pressure variations were greater when the load was 15,000 kilowatts than at full load. When testing a steam turbine rotor it was noticed that the shaft amplitudes were appreciable for one and a half hours after the rotor had started. This is attributed to the unequal heating of parts of the rotor during the early stage of the running. Three consecutive figures of revolution showing the displacements are given of a point on the axis of the turbine shaft when making 1800 revolutions per minute. The electric micrometer has also been applied usefully to get the indicator curves of high speed.

**PRODUCTION OF CARBON DIOXIDE BY FERMENTATION.**—Although at the present time certain breweries collect carbon dioxide evolved during fermentation, there are certain strong objections to what at first sight appears to be a profitable undertaking. In the first place, the gas differs from that produced by other methods, in that it contains as impurities traces of esters and of higher alcohols, a disadvantage which, however, loses much of its weight if the gas is to be used for carbonation purposes. A more serious objection is the fact that the collection of all the carbon dioxide evolved in brewery fermentations would result in overproduction and so render the procedure unprofitable. F. Stockhausen and F. Windisch (*Wochenschrift für Brauerei*, 45, 277 et seq.; 1928) have recently pointed out that the increasing technical uses

for the gas, notably in the frozen state as a substitute for ice, may provide the necessary demand. Further, they dispel the most important objection of all, based probably on a misinterpretation of the experiments of Prandtl and of Foth about forty years ago, that the effect of the pressure necessarily produced when the gas is collected in closed vessels over the fermenting vats is harmful to the yeast. For pressures of from 70 mm. of water to 1 atmosphere, they found that the rate of fermentation and the growth of the yeast are not arrested, but merely retarded, and that after about eight days the fermentation approaches normal conditions and finally yields a satisfactory beer. The yeast from the pressure fermentations was, moreover, healthier, had greater fermentative powers, and was less subject to degeneration than that normally produced. These latter results are striking from the purely biological point of view, and if they are confirmed on the large scale they should be of great practical importance.

**CARBON MONOXIDE COMBUSTION.**—At the Royal Society meeting on Nov. 1, Prof. W. A. Bone and his associates communicated the results of researches on the combustion of carbon monoxide, oxygen, and air mixtures at high pressures. With D. T. A. Townsend and G. A. Scott it was shown that the addition of hydrogen markedly accelerates the combustion. Starting at 50 atmospheres pressure and room temperature, the effect comes in abruptly when the proportion reaches 0.65 per cent. It is apparently a knock effect which may be eliminated by raising the bomb temperature to 100° C. When the proportion of hydrogen exceeds 1 per cent, this apparently catalytic effect of the hydrogen is replaced by the normal additive effect due to the admixture of a fast-burning hydrogen-oxygen mixture. A somewhat similar result follows the addition of steam up to 1 per cent, although the accelerative effect of hydrogen is the more marked. The slowing down of combustion when air is employed is ascribed to the nitrogen, for it does not occur when argon is substituted. With D. M. Newitt and C. M. Smith it was shown that the explosion limits of carbon monoxide-air mixtures when dry were narrowed by increasing the initial pressure from 32.2 to 64.4 atmospheres. With moist mixtures, increasing the initial pressure displaces both the upper and lower limits downwards without altering the explosion range.

**CONSTITUTION OF COAL.**—One of the methods of studying the constitution of coal is to examine the results of treating the fuel by organic solvents which, especially at high pressures, extract some of the coal substance. The extract may be resolved into several oily and solid fractions, and considerable discussion has ranged round the question as to whether one of these, and which, is responsible for the coking properties of a coal. It has been questioned whether the extraction made at 285° C. is purely physical or brings about a decomposition of the coal. Prof. W. A. Bone, L. Horton, and L. J. Tei, according to a paper presented before the Royal Society on Nov. 1, believe that no such decomposition occurs, and in this agree with the observations of other workers who find decomposition setting in only above 300° C. The extracted matter pre-exists as such in the coal. The authors found that the soft oily portion of the extract does contribute to the coking, although this is chiefly bound up with a solid fraction of the extract. From an examination of coals of varying geological age, it was concluded that the oily extracts are obtainable from the younger coals. The counterpart of the solid extract found in the less mature coals is of a phenolic character.



### The Corrosion of Condenser Tubes.

THE Seventh Report to the Corrosion Research Committee of the Institute of Metals (*J. Inst. Metals*, 32, 81; 1924) rendered it increasingly clear that corrosion (and resistance to corrosion) depends to a very great extent on the behaviour and properties of films, consisting chiefly of corrosion products, which form more or less completely on the surface of the metal. The Eighth Report, recently published, carries this aspect of corrosion considerably further so far as one type of wastage is concerned, namely, the 'impingement attack' produced by rapidly moving sea-water, particularly where free air is present, or where intermittent cavitation occurs.

This form of corrosion is well known to engineers; it results in a water-worn appearance of the tubes, and is due to the erosion of the protective film. Such films, even where they cannot be seen, may be inferred, for example, where a clean specimen of an alloy suffers attack while a specimen of the same material, previously immersed in slowly moving sea-water for a few days, is unaffected. Up to the present the investigation of the properties of such films has been tedious and, to some extent, uncertain, and the development in the present report of a method of examination which is both rapid and direct represents an achievement of great value.

The fact that a specimen of metal, when covered with a layer of corrosion products, has an electrical potential different from that of the same metal in a clean condition was already well known, but the difficulties involved in the measurement of this potential are by no means inconsiderable. In order to avoid inaccuracies due to polarisation and variations in the electrical resistance of the film, some form of null method was required which would take only the smallest possible current even when out of balance. It was therefore decided to use a three-electrode valve for the purpose, an idea which is, of course, quite well known, but has worked extremely well. An ordinary Marconi Osram D.E.R. valve is used with 33 volts on the anode and a negative bias of 1.5 volts on the grid. A sensitive moving coil instrument is placed in the anode circuit to indicate changes of the anode current. A potential divider, in series with a resistance, is connected across the filament battery, and is arranged so that a potential of from 0 to 500 m.v. may be applied in opposition to the unknown potential when this is in series with the grid bias battery. The potential thus applied is shown by a second moving coil instrument. A change-over switch is placed in the grid circuit, as shown in Fig. 1. When the switch is in the right-hand position, the millivoltmeter and the portion of the potential divider in use are short-circuited, and the positive pole of the grid bias battery is connected direct to the negative lead to the filament. Under these conditions the anode current shown by the instrument in the anode circuit corresponds with the normal grid potential and is noted.

By moving the change-over switch to the left-hand position the potential to be measured is connected in series with the grid bias battery, making the grid more negative and causing the anode current to fall. The unknown potential is then balanced out by adjusting the potential divider, and the point of balance is shown when the anode current returns to the value previously noted. When this is the case the reading of the millivoltmeter gives the value of the unknown potential. A third set of contacts is

arranged to open the anode circuit during the operation of the change-over switch.

In carrying out potential measurements during corrosion tests, the specimen used is a small disc, cut from a condenser tube, with a wire soldered to the back. The discs are cemented into ebonite holders with Chatterton's compound, the wires from the discs being run inside separate rubber tubes to insulate them from the sea-water or other corroding medium. The potential is measured between the specimen and a calomel electrode placed in a separate vessel connected with the tank in which the corrosion is occurring by means of a syphon. As the measurements are only relative, there is no need to use a standardised calomel electrode, the one actually used being made up with sea-water instead of potassium chloride solution. This avoided the necessity of taking precautions to prevent the diffusion of the sea-water into the electrode vessel.

In all the alloys tested, the calomel electrode has been the positive pole. The formation of a protective film makes the specimen more cathodic, with a

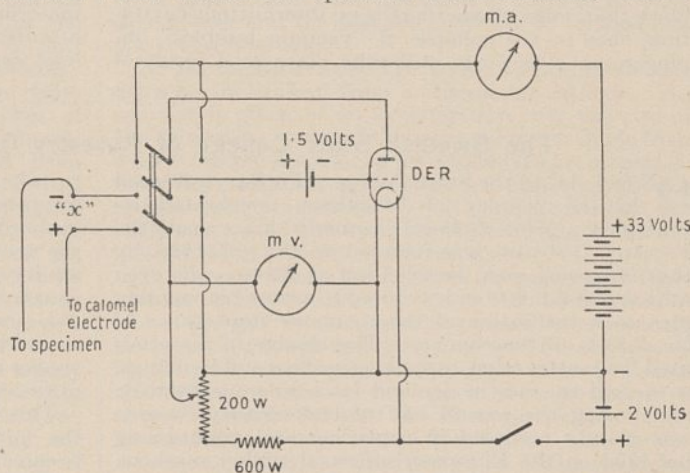


FIG. 1.—Circuit of valve 'potentiometer' used for measuring changes in 'film potential' during corrosion tests. By courtesy of the Institute of Metals.

diminishing potential difference between the specimen and the electrode. The breakdown of the film in a similar manner is shown by an increase of the difference of potential. This difference has little direct practical significance of itself. What is of importance, however, is the potential difference between the film-covered metal and the same metal without a film. This may be described as the 'film-potential' which, therefore, is simply the electrode potential of the clean metal minus that of the specimen covered with a film. Obviously the film-potential increases as film formation takes place and falls in the event of a film breakdown (Fig. 2). For the purposes of the present work it was taken that the clean metal was not very different from one freshly cleaned with sand paper or a steel brush.

In order to test the method, some experiments were carried out on a 70:30 brass tube containing 0.02 per cent of arsenic and on a special brass tube containing 2 per cent of aluminium. The curves obtained showed important differences in the behaviour of the film on the two alloys, particularly when the film was scratched under conditions of violent air-bubble impingement. In the case of the ordinary brass this resulted in rapid attack, but in that of the aluminium brass the injury healed up and the potential reached the original figure in less than twenty-four hours.



Having thus developed a method capable of yielding rapid and conclusive results, the work was continued on more practical lines, the main results of

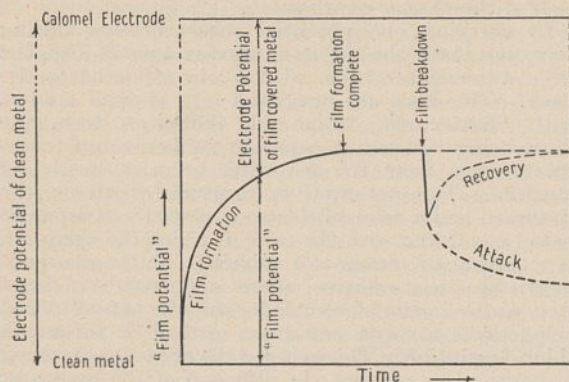


FIG. 2.—Diagrammatic curve of 'film potential' plotted against time, showing the relationship between 'film potential' and electrode potential. By courtesy of the Institute of Metals.

which may be summarised. It is shown in the first place that, even where there is no intermittent cavitation, that is, the collapse of 'vacuum bubbles,' impingement attack can still take place as a result of

air-bubble impingement. The size of these air-bubbles plays an important part in causing this type of corrosion, and, where the bubbles entangled in the water are very small, they appear to be comparatively harmless even under conditions of strong impingement. There are, therefore, two main causes of impingement attack, intermittent cavitation and air-bubble impingement, but in both cases the effect is known to be dependent on the occurrence of swirling motions in the water. Rotatory motion of the water should therefore be prevented both in the inlet water-box and inlet piping, if necessary by positive arrangements to guide the water. Air bubbles in the water, except very small ones, should be avoided, and the suggestion is made that a grid in front of the tube-plate of the condenser may be so designed that any bubbles passing through it are broken up sufficiently finely as to be harmless when they enter the tubes.

When the conditions cannot be moderated by mechanical means, the most hopeful solution of the problem would appear to be the use of tubes of a material specially resistant to this form of attack. Of such tubes already on the market those of 70:30 cupro-nickel seem to be quite satisfactory, but other materials, such as the aluminium-brass, to which attention has already been directed, appear to be at least as good.

F. C. T.

### The Swedish State College of Forestry Centenary Celebrations, 1928.

ON Oct. 14-16 the State College of Forestry, situated in the vicinity of Stockholm, celebrated its centenary. This College, formerly known as the Forestry Institute, was founded on Oct. 15, 1828, by that far-seeing man, Israel Adolf av Ström, who even at that distant date endeavoured to arouse his countrymen to a realisation of the economic importance of the forests of the country. The change in materials used for construction, especially in ships and buildings, witnessed the rise in demand for coniferous timbers, and during the second half of last century Sweden was mainly occupied in capturing and maintaining her hold on the European softwood timber markets. The advice of the few, who understood the danger which the more or less unrestricted lumbering in the forests which had been acquired by the great timber companies and in those numerous areas of varying size (designated farm-forests), owned by tenant farmers, went unheeded. The power of the lumbering interests predominated and the country undoubtedly prospered thereby. Before the end of the century, however, the Government became alarmed at the position and appointed a committee to consider what legal restrictions could be placed on the unchecked exploitation combined with a want of effective management in the greater bulk of the privately owned forests of the country. As a result of the committee's report a General Forest Law was enacted in 1903 and brought into force in 1905, which made it imperative that all areas of forest felled should be replaced by a new young tree crop within a reasonable period. At the same period a revival in the scientific aspects of forestry took place, and in order to endeavour to associate the scientific and commercial aspects of this question the Swedish Forestry Association was founded in 1903.

It is not the purpose of this notice to trace the great progress which the present century has witnessed in forestry matters in Sweden. The War acted as a setback to some extent, in so far that fellings were greatly increased to take advantage of the fantastic prices prevailing in the European markets. But perhaps, as a natural outcome of the extraordinary fellings made

to take advantage of exceptional prices, the swing of the pendulum focused the attention of both the State authorities and those engaged in and dependent upon the enormous export trade upon the question of their ability to maintain the position, one vital to the country. To Great Britain the matter is of considerable importance, since we depend at present for a considerable amount of our coniferous imports—timber in various semi-fashioned and fashioned forms, pit-wood and, to an increasing degree, wood-pulp.

This being the position, it is not surprising that in the forestry revival the State College of Forestry became an important centre, since the State forestry probationers are trained there, and many of the larger timber companies either select fully-trained young men from the College or nominate their own probationers to proceed to the College. In some cases these men remain for a longer period as research students at the centre before joining their companies; for many of the latter undertake forest research work of their own and have their own research laboratories. This has been necessitated since conditions vary in different parts, and it is well recognised that it is impossible to localise forestry research for the whole country at any one centre. The timber companies of Sweden own a considerable portion of the most valuable forest land, the State forests occupying for the most part the less valuable soils in the north. The companies have a large capital invested in their undertakings and they have now realised to the full, a recognition which has only come slowly with the lumbering interests and is still absent in many parts of the world, that if this capital is to be safe in the future they must reafforest areas felled over so as to have a succession of crops to provide materials to keep their mills and other industries running. In other words, that primeval forests cannot last for ever. Sweden had arrived at that realisation by the beginning of the present century.

The importance attached to the centenary celebrations of the State College is therefore understandable. The King of Sweden graced the proceedings on two occasions, whilst the Crown Prince was present



at most of the meetings, and presided at the State banquet, at which he gave an excellent résumé of the present position of forestry in Sweden and the enormous importance of the forests to the country, half of the exports of which consisted of forest produce in one form or another. The Crown Prince showed that he had a first-hand knowledge of the question; the best summary of his speech being the remark: "If you properly manage your forests they will be preserved for all time."

The chairman of the College Board, as also of the Forestry Association, was that remarkable man Admiral Arvid Lindman, recently appointed Prime Minister of the country. The Admiral spoke several times and laid especial stress on the great importance of the work the State Forestry College was accom-

plishing, and that it now held an unquestioned position in the country; and nowhere less unquestioned than amongst the great commercial industrial element dependent upon the forest for the raw product of their industries, as the indispensable centre at which forestry education in all its aspects was conducted, and that its functions were yearly becoming more valuable to the country.

The celebrations were attended by important delegations from universities and forestry colleges from most of the European centres, namely, Germany, Great Britain (from the Universities of Oxford, Cambridge, and Edinburgh), France, Austria, Belgium, Czechoslovakia, Yugoslavia, Poland, Soviet Russia, Finland, Norway, Latvia, etc., with two representatives from universities of the United States.

### Radioactive Changes and Thermionics.<sup>1</sup>

**H. J. BRADDICK AND H. M. CAVE.**—The rate of emission of alpha particles from radium. A knowledge of the rate of disintegration of radium as measured by the number,  $Z$ , of  $\alpha$ -particle disintegrations taking place in unit mass of radium in unit time is of considerable importance in the interpretation of radioactive changes, and in particular of the energy relations involved. Recently published values for this quantity  $Z$  range from  $3.40 \times 10^{10}$  to  $3.72 \times 10^{10}$ . The heat evolution of radium and its products as determined experimentally is in agreement with that calculated from the number and energy of the  $\alpha$ -rays, recoil atoms,  $\beta$ - and  $\gamma$ -rays if a value is assumed for  $Z$  of about  $3.7 \times 10^{10}$ .

The authors have made a determination of the number  $Z$  by measuring the total charge carried by a known fraction of the  $\alpha$ -rays from a source of radium active deposit, assuming that the normal  $\alpha$ -particle carries twice the electronic charge, taken as  $4.77 \times 10^{-10}$  e.s.u. The experiment was carried out in a highly evacuated chamber placed in a strong magnetic field which served practically to eliminate  $\beta$ -ray and  $\delta$ -ray effects. The  $\alpha$ -ray current was measured by the Townsend compensation method, and the activity of the source was determined continuously throughout an experiment by  $\gamma$ -ray methods. Possible sources of error were investigated.

The value obtained is  $3.68 \times 10^{10}$  and leads to a value for the heating effect in good agreement with that observed in recent experiments. It seems that there is no necessity to assume the existence of an unrecognised heat-producing mechanism in the disintegration.

**P. WHITE AND G. MILLINGTON.**—The velocity distribution of  $\beta$ -particles after passing through thin foils. The source of  $\beta$ -particles was radium-B and -C on a narrow platinum wire, and their velocities were measured by the usual photographic method with semi-circular focusing. The source was covered by a thin screen of mica pierced with two or three small holes, the straggled and the unstraggled lines being obtained on the same plate. The relative number of particles falling on each part of the plates was determined from the density curves by using the known density-calibration curve for the plates. The frequency curves so obtained were corrected for the finite width of the unstraggled lines, and the abscissæ expressed as  $\delta(H\beta)$ . The curves for  $H\beta$  1410 to 1938 for thicknesses of mica 2 to 6 mgm. per sq. cm. are expressed in terms of a fundamental straggling curve. It is found that many more particles lose large amounts of energy than theory predicts. The relation between the most probable loss of velocity and the thickness of foil shows a small systematic

divergence from Bohr's theory which is beyond the limits of experimental error, and the same is found for the relation between initial velocity and the most probable loss of velocity. The assumptions underlying Bohr's theory are discussed in relation to these divergences and the possible advances to be made on the theoretical side.

**N. A. DE BRUYNE.**—The action of strong electric fields on the current from a thermionic cathode. An account is given of an investigation into the rise of the saturation current from a thermionic cathode from a hot tungsten filament as the applied field is increased. Schottky's relation holds good for fields up to one million volts per centimetre; it is concluded that the electrons pulled out by fields of this magnitude have a Maxwellian velocity distribution.

In the case of one of the three filaments used there was an apparent departure from the Schottky relation; the only reasonable explanation of the anomaly is that at high field strengths produced adventitiously by the presence of irregularities on the cathode surface the Schottky relation no longer holds good; it is therefore concluded that the electrons pulled out by strong fields do not have a Maxwellian velocity distribution. From the results a value of the electronic charge is deduced.

**J. C. McLENNAN AND G. GREENWOOD.**—The decomposition of ammonia by high speed electrons. In these experiments, carried out with a Collidge cathode ray tube, the pressure range studied was 0.5-4.0 mm. On bombarding ammonia at pressures within this range an equilibrium between hydrogen, nitrogen, and ammonia was established. By the use of rays of constant velocity the percentage decomposition decreased with increasing gas pressure. When the initial pressure of the gas was kept constant and the velocity of the rays varied, the percentage decomposition was found to be a linear function of the voltage applied to the cathode ray tube. No decomposition was found to occur below 82,000 volts, apparently because no rays with less speed penetrated the window. The presence of an excess of nitrogen increased the quantity of ammonia decomposed, while the presence of excess hydrogen lessened it.

Analysis of the results obtained showed that each electron having a definite velocity depending on the constant applied voltage was responsible for the decomposition of a definite quantity of ammonia molecules regardless of the pressure of the gas. With electrons of different speeds the amount of ammonia decomposed per electron increased with the speed. When the ammonia contained nitrogen in excess, the primary decomposition of the ammonia was not affected by the presence of the nitrogen. With hydrogen in excess, however, the speed of the initial decomposition of the ammonia was decreased.

<sup>1</sup> Abstracts of papers read before the Royal Society on Nov. 1.



## Proposed New Constitution for Belgian Telegraph and Telephone Administration.

THE Minister responsible for the Belgian telegraph and telephone services, which at the present time are conducted by a self-contained department of the Ministry of Railways, Marine, Posts, Telegraphs, Telephones, and Aeronautics, has presented a report to his government indicating some of the difficulties which are experienced in providing adequately for the public needs in relation to these two services under the existing organisation of the department. Particularly, it has been found that the provisions of a law of 1846 dealing with the State finances are not sufficiently elastic to permit of the existing telegraph and telephone systems being maintained and developed with the degree of efficiency necessary in an undertaking of a commercial and industrial character, and consequently a new constitution is required for the conduct of these services. At the same time it is considered essential that the public telegraph and telephone systems in Belgium should continue to remain under State control.

The Belgian Government has been impressed with the arguments advanced in the report above mentioned in favour of the proposed reorganisation, and recognises the need, not only from the point of view of the economic life of the country, but also from that connected with the restoration of the nation's financial stability, for immediate action being taken to alter the present arrangements for carrying on these two important services. Accordingly a Bill, which the Government states is of an urgent nature, has been introduced by it in the Belgian Senate providing for the creation of a new "Telegraph and Telephone Administration."

It is the intention of the Belgian Government that

the proposed Telegraph and Telephone Administration shall be endowed with the legal status of a corporation, which will have imposed upon it the duty of conducting the public telegraph and telephone services, including wireless, in the national interest, on lines similar to those in vogue in up-to-date industrial and commercial undertakings. The framers of the Bill have sought to remove, so far as it is possible to do so, the risk of a conflict between the State and the proposed Telegraph and Telephone Administration.

The Bill provides that the management of the Telegraph and Telephone Administration shall be entrusted to a board or commission, of which the Minister in charge of the telegraph and telephone services, or his deputy, is to be the president. There are to be eighteen other members, and it is expressly laid down that three of them shall be selected by reason of their special knowledge of the technical side of the problems connected with these services. Of the remaining members, eleven are to be chosen from lists prepared by certain Chambers of Commerce and other important institutions, whilst one member is to be nominated by the Finance Minister, and three others, who must be on the staff of the Telegraph and Telephone Administration, are to be nominated by the president of the commission. The existing telegraph and telephone networks will be transferred to the commission, which will make payments to the Belgian State Treasury in accordance with the provisions of the proposed law, which deals fully with the method in which the public telegraph and telephone undertakings are to be financed. The text of the Bill, *in extenso*, has been published in the issue of *L'Echo de la Bourse* (of Brussels) for Oct. 22, 1928.

## The Faraday Society.

### CELEBRATION OF THE TWENTY-FIFTH ANNIVERSARY.

AN event of considerable importance and interest in the world of science is the twenty-fifth anniversary of the foundation of the Faraday Society. This was celebrated on Friday, Nov. 9, first by a luncheon which was attended by representatives of scientific institutions from the leading countries of the world, and then by the delivery of the first Spiers Memorial lecture by Sir Oliver Lodge at the Royal Institution. Prof. T. M. Lowry, president of the Faraday Society, presided at the luncheon, at which were representatives of the Union Internationale de Chimie Pure et Appliquée, the Bunsen Gesellschaft, the American Chemical Society, the National Research Council of Italy, the Institute of Physics, the Institution of Electrical Engineers, the Physical Society, and others.

During the course of the speeches at the luncheon, Prof. E. C. Bailman, representing the Union Internationale de Chimie Pure et Appliquée, presented to the Faraday Society two volumes containing correspondence between Oersted and the technical societies, and also between him and Faraday. One other item of interest during the luncheon proceedings was the great compliment paid to the late Mr. F. S. Spiers for his organisation of the general discussions of the Faraday Society—which it was suggested were rendered the more valuable by the co-operation of men of science in other countries—and the suggestion of the president that there might be organised international general discussions which would take place alternately in different countries.

Sir Oliver Lodge took as his subject for the first

Spiers Memorial Lecture, "Some Debatable Problems in Physics," in which he first discussed the seat of the electromotive force in the voltaic pile. He related something of the discussions that have taken place upon this matter, and commented on the fact that they have continued throughout the nineteenth century and are continuing into the twentieth. At the same time, he rather suggested that although there have been acute differences of opinion on the matter, the advocates of the different points of view are really much of the same opinion, and some of the difficulty has been introduced by different modes of expression. Indeed, taking Poynting's diagram of energy paths, Sir Oliver suggested that this is a complete reconciliation of the views on both sides and justifies the rival views. It indicates, said Sir Oliver, that the rival views have a great deal in common, but that those who have been expressing them have not done so in the most convenient way. It is legitimate but not convenient to define potential as that in the air near the metal; if we do that we get into trouble.

In the latter part of the lecture Sir Oliver Lodge dealt with one or two matters indicating how small effects observed in the laboratory become very important as time goes on. He commented on the fact that the contact of two metals, as in the voltaic pile, led to modern electrical generation, and how closely the small observation of Becquerel on spontaneous radioactivity is related to atomic disintegration. From this he passed on to the dissipation of energy, and asked the question whether, after all, matter does turn into radiation and that that is the end of it.



It is, he said, a debatable point; is it really an irreversible process? Is it not possibly and conceivably a reversible process? Are there any possible circumstances in which radiation can turn back again into matter? Sir Oliver suggested that irreversibility is not proved, and that the material universe may be a cyclical process after all. Matter has been clashing together under gravitation, developing heat; that seems to be irreversible, but how does the energy get back? Not as matter. If at the confines of the earth the heat so developed could be turned back again into matter, it could form a sort of continual pulsation and cyclical change without beginning and without end.

Sir Robert Hadfield, who was in the chair at the Royal Institution, and with his usual keenness for the affairs of the Faraday Society had prepared an interesting little brochure giving the history of its development and work, mentioned an important matter in connexion with the Royal Institution. There are plans in hand, he said, for improving the building which it is very necessary should be carried out, and he expressed the hope that all the technical and scientific societies would give every assistance in the matter. Sir Robert referred in his pamphlet to important work which has been accomplished by the Faraday Society during the twenty-five years of its existence, laying special stress on its contributions to the solution of the problem of the fixation of nitrogen. When the Nitrogen Products Committee was formed in 1916, largely at the instance of the Faraday Society, the Society was directly represented, and no less than seven other members were also members of the Society, while many of those concerned in the work of that Committee now occupy prominent positions.

### University and Educational Intelligence.

**BIRMINGHAM.**—The Huxley Lecture for 1929 is to be delivered by Sir Humphry Rolleston on Feb. 12, the subject being "The Nature of Disease."

The James Watt Fellowship for 1929 has been awarded to Mr. D. Watson.

**CAMBRIDGE.**—Dr. T. D. Cockcroft, Clerk Maxwell student in the University, has been elected to a fellowship at St. John's College.

The Regent House has decided to accept the offer of the International Education Board of a gift of £700,000 towards the proposed new library and for the development of physical and biological studies. Details of the scheme were given in our issues of Oct. 6, p. 556, and Oct. 20, p. 632.

EDUCATIONAL relations between the United States and Germany will be fostered by a tour to take place next summer under the joint auspices of the International Institute of Teachers College, Columbia University, New York City, and the Central Institute for Education and Instruction, Berlin. Assembling at Hamburg or Bremen, the party are to visit, during the six weeks beginning June 17, schools of different types in various cities under the official direction of the German educational authorities, proceeding afterwards to a conference of the World Federation of Education Associations at Geneva, to be held during the last week in July.

THE Committee of the Leplay House Educational Tours Association announces that during the Christmas vacation a group for historical and social studies will be going to Lisbon, under the leadership of Mr. Barry

Parker, vice-president of the Town Planning Institute, Burgos, Madrid, and Toledo, and other places in Spain, are included in the itinerary. Further, Prof. P. Geddes has again invited friends of Leplay House to go to Montpellier. A few days will be spent in visiting Avignon, Nîmes, and other places of interest. Mr. G. Morris will lead the group. Particulars can be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

FROM the Universities Bureau of the British Empire we have received a copy of a useful prospectus for 1928-29 of the professional schools, post-graduation courses, and specialist studies in the universities and university colleges of Great Britain and Ireland. This pamphlet gives, in forty pages, first, a summary of information under those headings regarding each university (except Oxford and Cambridge) and university college; secondly, combined lists of their professional schools under the headings—*theology, law, medicine, dental science, veterinary science, pharmacy, music, art, architecture, journalism, librarianship, commercial science, engineering, metallurgy, mining, agriculture, etc., and education*; and, lastly, alphabetical lists of subjects of study to which special attention is devoted in the several institutions. By reference to these lists one can ascertain at a glance where special facilities are to be found for the study of, for example, aviation and aero-engineering (Cambridge, London—Imperial College and East London College—Oxford, and Glasgow), colloidal chemistry (Bristol, Leeds, and Manchester), economic entomology (Liverpool, London, Manchester, and Edinburgh), photography (Manchester), and so on. This pamphlet will no doubt be distributed to universities in other countries, where it should prove extremely useful to advanced students proposing to study abroad.

THE Board of Education has published another of its useful booklets, this time on the supply of literature—that is, reading books and libraries—for public elementary schools ("Books in Public Elementary Schools." Pp. xxii+163. London: H.M.S.O. 1s. 3d. net). It starts from a statement of the admitted inadequacy of the expenditure of the authorities under this heading. The Board's Committee is able to make out an unanswerable claim. The expenditure on books only averages 1s. 7½d. a head, taking elementary schools of all grades in England and Wales together. In the central schools alone, that is, the schools for scholars from twelve to fifteen or sixteen years of age, it amounts to just under five shillings. Even this is small enough, and for the other schools the amount is ludicrous. The report is emphatic that children in elementary schools need more books and books of better quality, though a steady improvement in the quality is noticed. Of the many detailed suggestions that are made it is only possible to mention one or two. There should be a collection of books of reference in every school, both for pupils and teachers, and children should be taught as part of their education how to make use of a book of reference. Arrangements are also suggested by which each pupil might acquire a small selection of books which especially interest him. The last recommendation is that special attention should be given in training colleges to guiding teachers in the right principles for the selection of books, for on them ultimately the choice of nearly all the books in an elementary school must rest. A regret seems justified that no one on the Committee was specially interested or qualified on the subject of books on science, and hence this section, and that on science and invention in the section on history, are conspicuously weaker than the rest.



## Calendar of Customs and Festivals.

### November.

**SEED-TIME IN ANCIENT EGYPT.**—The sowing of the corn in ancient Egypt, which took place in November, was observed by the farmer, according to Plutarch, as a period of mourning and solemn observance. It was also at this time of the year that a feast of lights was held at night, and the death of Osiris was displayed as a mystery at the grave of the god at Sais. Frazer suggests that the 'Feast of Lights' may have been an 'All Souls' festival. The people mourned and beat their breasts in their sorrow for the death of the god, and an image of a cow made of gilt wood, with a golden sun between its horns, was carried out of its chamber. In Plutarch's day it was carried seven times around the temple. This was held to symbolise the search of Isis for the body of the god Osiris.

Plutarch also records that during the four days from the thirtieth to the sixteenth of the month Athyr (November) the people mourned for Osiris, when the image of the cow was swathed in black. Osiris was said to have been killed on the seventeenth of the month. On the nineteenth day the priests, accompanied by the people, went down to the sea carrying a shrine containing a gold casket into which they poured fresh water, whereupon the spectators shouted that Osiris was found. After that, vegetable mould was made into the shape of a moon and robed and ornamented. This represented the dead god come to life.

The ritual, as is apparent from the various accounts that have come down to us, varied from place to place. According to the account of the Denderah inscription, which describes the ceremonies of the Ptolemaic period, they lasted eighteen days, from the twelfth to the thirtieth day of the month Khoiak, and represented the death, dismemberment, and resurrection of Osiris. The ceremony began with ploughing by two black oxen, and the sowing of barley, spelt, and flax, and included a voyage of Osiris, attended by thirty-four images of deities in thirty-four tiny boats of papyrus, illuminated by three hundred and sixty-five lights. On the thirtieth day the effigy of the god was laid to rest in a sepulchral chamber, the effigy of the previous year having already some days before been removed and placed on boughs of sycamore. In a chamber of the temple of Isis at Philæ, the resurrection of Osiris was symbolised in a representation of the body of the god from which sprang stalks of green corn (see Frazer's "Golden Bough," Abridged Edition, p. 371 *fol.*).

### November 23.

**ST. CLEMENT**, a follower and coadjutor of St. Paul, said to have been thrown into the sea with an anchor round his neck; hence his emblem of an anchor. On the sea retiring miraculously for a distance of three miles, his body was found within a stone chest in a chapel, and in commemoration the miracle of the retirement of the sea was repeated annually for a period of seven days. St. Clement's day in the popular calendar was regarded as the first day of winter. In medieval times it was the custom for children to parade the streets on this day. In Worcestershire boys went from house to house collecting pence and reciting verses in honour of both St. Clement and St. Catherine. Sometimes they were accompanied by men, who received gifts of cider and ale. This appears to be a relic of an older custom by which, on the night of St. Clement, house-to-house visits were paid for the purpose of drinking ale. In the Clog calendars the day was marked with a pot, as an indication of the character of the festival.

A similar procession of children asking for doles of cakes, a custom known as 'souling,' takes place in connexion with Halloween (see Oct. 31 and Nov. 1 and 2) and also in connexion with the feast of St. Katherine (Nov. 25). The customs still survive in Cheshire, Staffordshire, Shropshire, and Warwickshire. 'Clementing' has been recorded in East Sussex, and in a proclamation of 1540 the custom of children making processions on St. Nicholas, St. Katherine, St. Clement, the Holy Innocents, and such like days, was forbidden.

It has been suggested that the economic aspect of the Celtic New Year on Nov. 1, when dues of agricultural produce were payable, has been transferred under Christian and ecclesiastical influence to the feasts of St. Clement and St. Katherine. Nov. 23, old St. Martinmas, was recorded in 1812 as still observed as one of the ancient quarterly periods of the year on which a few rents still became payable. In Walsall, in a code of 1440, St. Clement's day was the date for the rendering of the Mayor's accounts, the wardens of the guilds making up their accounts on St. Katherine's day. Down to a late date the day continued to be known as St. Clement's accompt, and apples and nuts were thrown from the Guildhall windows to the crowd. It is therefore probable that the ale given to the men and the apples given to the children are a relic of the entertainment frequently recorded as given to those paying dues.

St. Clement is the patron saint of blacksmiths, to whom he was known as 'Old Clem.' At one time his feast was celebrated annually in the dockyard at Woolwich by the election of one of the apprentices to serve as Old Clem. His face was masked, his head covered with an auburn wig, and he wore a long white beard. He sat in a large chair covered with bunting, with a wooden crown and anchor above it. A wooden anvil was before him, and in his hands he had wooden tongs and hammer. A mate with wooden sledge and others with banners and torches, battle-axes, etc., attended him. The party then formed a procession, Old Clem being shouldered, and paraded the town, visiting the residences of the officials of the dockyard and asking alms, the proceeds being spent in a supper.

**MOCK MAYORS.**—Mr. Frank H. Perrycoste of Polperro writes in reference to Mock Mayors in Cornwall (see NATURE, Sept. 29, p. 497), that he has recently found a note that on June 8, 1797, Sir Harry Trelawny paid William May 2s. for attending at Pelynt to prevent the Mayor's chairing. Mr. Perrycoste suggests that this was a payment to the parish constable or an official for his services in preventing any riot or undue disturbance at the annual election of a mock mayor at Pelynt, a small agricultural village near Polperro.

Cornwall is not the only county in which the election of a mock mayor is recorded. At the beginning of the last century at Weston, a parish near Bath, such an election used to take place annually after a dinner, when the mayor entered the hall in full procession and, after the administration of the oath, an armed champion threw down a glove in challenge. Documents from the charter chest were recited, including the original charter, "granted by Julius Caesar." A similar election took place in connexion with the 'Renwick Mop' at Randwick, Stroud, on the Monday after Low Sunday, i.e. the second Monday after Easter. This latter was a water ceremony, the mayor being carried in a chair to a pool near a church, when he was lowered until his feet touched the water, while he and the bystanders were drenched with water.



## Societies and Academies.

## LONDON.

Royal Society, Nov. 8.—S. B. Schryver and E. J. Candlin: Investigations on the cell-wall substances of plants, with special reference to lignification. Substances accompanying cellulose in plant cell-walls may be divided into three classes: (i) lignins, (ii) hemicelluloses, (iii) pectins. Products belonging to the two latter classes are formed by conjugation of sugar acids (glycuronic and galacturonic acids) with sugars. These acids are designated 'uronic acids,' and hemicelluloses and pectins appear, therefore, to belong to a distinct chemical group, for which the name 'polyuronides' is suggested. Pectins undergo decarboxylation on treatment with weak alkaline solutions, even at room temperature, yielding among other products, hemicelluloses, still containing uronic groups, but resisting decarboxylation on treatment with alkalis, and resembling in all respects hemicelluloses isolated directly from timbers. The results indicate that decarboxylation takes place when plant tissues lignify.

R. R. Gates and F. M. L. Sheffield: Chromosome linkage in certain *Oenothera* hybrids. An account is given of five generations of hybrids from *O. (biennis* × *rubricalyx*) × *ammophila* and *O. ammophila* × (*biennis* × *rubricalyx*) and their cytological peculiarities. The chromosome linkages appear to be a means of explaining some of the genetic behaviour observed in these and similar hybrids. Reciprocal  $F_1$  hybrids are very different. They are patroclinous. It may be that the *Oenothera* linkage arose between non-homologous chromosomes. It appears probable that a relation exists between the chromosome linkage and the genetic linkage which is a characteristic feature of the genus.

S. Dickinson: Experiments on the physiology and genetics of the smut fungi. After isolating a chlamyospore of the covered smut of oats (*Ustilago levis*) and allowing it to germinate, the first sporidium formed by each of the four segments of its promycelium was isolated, transferred to test-tube slopes, and allowed to develop. Four cultures of strains were obtained from one chlamyospore, and all four differed. The segregation of these cultural characters was on a 2:2, 3:1, and 4:0 basis. This may take place in either the first or the second of the reduction divisions. No conclusive evidence of somatic segregation has yet been obtained. The cytoplasm has no determining influence on cultural characters so far described.

R. J. Ludford and W. Cramer: The mechanism of secretion in the thyroid gland. The cells of the thyroid discharge into the lumen of a vesicle and so into the blood stream. There is no alteration of direction of discharge during prolonged increased functional activity. There is no evidence that the cells secrete normally direct into the capillaries. In exophthalmic goitre, in mouse and man, there is enlargement of mitochondria and of Golgi apparatus—a condition characteristic of intense secretory activity. The polarity of the Golgi apparatus is frequently reversed. The secretion droplets, formed in association with the reversed apparatus in the case of the mouse, are discharged direct into the capillaries.

Ruth Deanesly: A study of the adrenal cortex in the mouse and its relation to the gonads. Well-marked normal changes are described in the cortex of the female gland which show no correlation with oestrous cycle in the unmated animal. Pregnancy accelerates these normal changes, but has no specific effect on the

structure of the gland. In the castrated male an adrenal of female type develops. Ovariectomy has no effect on the adrenal. Double adrenalectomy was performed on a number of male and female mice; these bred normally after operation.

W. J. Dakin: (1) Anatomy and phylogeny of *Spondylus*, with a particular reference to the lamellibranch nervous system. An investigation of the bivalve mollusc, *Spondylus*, was undertaken in order to determine the relationship of this genus to *Pecten*, for although *Spondylus* possesses eyes of a type almost or exactly the same as those of *Pecten*, the habits of the two genera are very different. *Spondylus* lives fixed by its shell to submerged rocks, etc.; *Pecten* moves about actively and is able to swim. Anatomically *Spondylus* is a close relative of *Pecten*, and its structure can be best interpreted by assuming it derived from a form not unlike *Pecten maximus*. The nervous system differs remarkably from the type so familiar in all other lamellibranchs. The pedal ganglia are connected by long nerves to the visceral ganglion and cerebro-pedal connectives are not present as distinct nerves.

W. J. Dakin: (2) The eyes of *Pecten*, *Spondylus*, *Amussium*, and allied lamellibranchs, with a short discussion on their evolution. The eyes of *Pecten*, *Spondylus*, *Amussium*, *Chlamys*, and, in all probability, *Pedum* may be considered identical in structure. No lamellibranchs outside the suborder Pectinacea have eyes of the same type, and within the group the eye structure is remarkably constant, notwithstanding diversity of habits. The development of the eye throws little or no light upon its evolution. The eyes in the Pectinacea are functionally not so highly developed as their complex structure might lead one to suppose. Internal factors may have played a greater part in their evolution than natural selection.

C. E. Walker: Artefacts as a guide to the chemistry of the cell. When mixtures containing albumen, peptone, gelatine, and lipins, with minute globules of methyl myristate or laurate suspended in them to act as artificial nuclei, are suitably fixed and treated with osmic acid, lipins separate out and are deposited, largely near to the globules, and are blackened. If, however, yellow phosphorus be dissolved in the myristate or laurate, the greater part of the lipins is deposited upon the actual surface of the globules. This suggests that nuclear content may determine the position in which lipins are fixed. If these mixtures with myristate or laurate containing phosphorus are kept at a temperature of 30° C., lipins appear to become gradually saturated or oxidised, and appearances on fixation resemble the changes described as occurring in 'Golgi apparatus' in cells of animals suffering from 'phosphorus' poisoning.

## PARIS.

Academy of Sciences.—Sept. 24.—G. Bigourdan: The instruments and observations of Delambre at the rue de Paradis.—V. Grignard, L. Lapayre, and Tchéou Faki. The monomagnesium compound of acetylene. A study of Oddo's process, the reaction between  $C_2H_2$ ,  $MgBr$  and acetylene. Large increases in the yield can be obtained by working under certain conditions detailed.—E. Bataillon: Analytical studies on the maturation of the eggs of Batrachians. All the experiments described agree with the hypothesis of an osmotic hyperpressure in immature eggs.—Georges Bouligand: Order of measurement and dimension of closed ensembles.—O. D. Kellogg: The unicity of harmonic functions.—Luis Roden: A new method for measuring the solar parallax. This method is based



on measurements of radial velocities of rotation of the solar equator and observations giving the period of complete rotation. The solar diameter obtained by this method (1,390,857 km.) gives a figure for the sun's mean distance very close to those given by other methods.—G. Bruhat: The geometrical properties of diagrams relating to saturated vapours.—Erik A. Holm: The state called the 'Tama-Zustand.' From the hypothesis of Von Dallwitz-Wegner, it follows that in a vessel at a uniform temperature and containing a gas sufficiently rarefied, there should exist a pressure of a new order named the gravimolecular pressure. Experiments are described which appear to prove the existence of such a pressure.—T. Peczkalski and J. Cichocki: The electrical conductivity of the vapours of potassium chloride. A detailed account of experiments leading to the conclusion that potassium chloride vapour can be electrolysed.—R. de Malle-mann: Calculation of the internal field of polarisation.—Paul Bary: Structure of the filaments obtained by drying up ferric solutions. A study of the structure of the solid material obtained by the slow evaporation of aqueous solutions of colloidal ferric hydroxide.—Jean Savard: The ultra-violet absorption curves of the terpene alcohols in relation with their constitution.—Albert Baldit: Magnetic measurements in the south-west of France.—Et. Burnet: The pathogenic power of *M. melitensis* and of *B. abortus* for the ape and for man.

## GENEVA.

Society of Physics and Natural History, July 5.—Robert Bach: A verification apparatus for optical pyrometers. The author has constructed a very simple apparatus, which is based on the realisation of an approximately black body and allows the standardisation of any optical pyrometer by the observation of a certain number of melting points, for arbitrary experimental conditions.—Léon W. Collet and Augustin Lombard: The presence of a plane of overlapping of the Morcles stratum in the circle of the *Fer à cheval* (Sixt Alps, Haute-Savoie). The sedimentary layer of the crystalline massif of the Aiguilles Rouges is represented to the south of the *Fer à cheval* hut by Trias and crushed Malm. On these rests the Morcles stratum which starts with thin schists of the lower Lias, supporting the limestone zones of the middle Lias.—Léon W. Collet and Edouard Paréjas: The crystalline wedge of Fontanabran, the massif of the Aiguilles Rouges. The gneiss which forms the summit of Fontanabran overlaps a lower crystalline element through the intermediary of the Triassic layer of the latter (quartzites and argillites). Further, the extremity of the wedge, broken by an Alpine direction fault (N. 45° E.), sinks about fifteen metres.

## PRAGUE.

Bohemian Academy of Sciences and Arts, Class II. (Science and medicine), Oct. 19.—V. Sotornik: Minerals of alpine paragenesis from Kutná Hora.—V. Posejpal: Second contribution to the study of light-ether: Ultra-penetrating radiation, heat of the earth and sun, the source of Swanne's electrons keeping up the earth's negative charge, are accounted for by the hypothetical neutron constitution of the ether.—O. Borůvka: A certain type of minimal surfaces in four-dimensional space of constant curvature.—J. Korous: The series of Laguerre polynomials.—J. Hronec: Linear differential systems of second order solvable by hypergeometric series.—V. Dolejšek and M. Valouch: The precision of X-ray spectra and Moseley's law. The causes of irregular deviations from Moseley's law are due to variations of intensity,

tension, and chemical binding; periodic regular deviations occur from the formula

$$\sqrt{\frac{r}{R}} = a + bn + cn^2 + dn^3 \quad (n = \text{atomic number}).$$

—M. Mikan: Isologic complex of Cremona space quadratic transformations. On the quadratic correspondence of 12 pairs in space, and the reproduction of 6 points.

## Official Publications Received.

## BRITISH.

First Cape Catalogue of Stars for the Equinox 1925-0. Catalogue of 4569 Stars from Observations with the Reversible Transit Circle made at the Royal Observatory, Cape of Good Hope, during the Years 1918-1925, under the direction of Dr. H. Spencer Jones. Pp. xliii+123. (London: H.M. Stationery Office.) 27s. 6d. net.

Observations made at the Royal Observatory, Greenwich, in the Year 1926: Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. 10+Axiii+A56+iv+B20+C40+Dix+D123+6+Exvi+E86+Exi+F34+22. (London: H.M. Stationery Office.) 40s. net.

Declinations of Stars derived from Observations of Transits in the Prime Vertical with the Altazimuth in the Years 1923-26, under the direction of Sir Frank Dyson. Pp. v+64. (London: H.M. Stationery Office.) 7s. net.

Annals of the Cape Observatory. Vol. 10: Spectroscopic Researches. Part 8: Radial Velocity Determinations, including a Spectroscopic Determination of the Constant of Aberration, the Orbits of 13 Spectroscopic Binary Stars, and the Radial Velocities of 434 Stars. By Dr. H. Spencer Jones. Pp. 246. (London: H.M. Stationery Office.) 20s. net.

Magnitudes of Stars contained in the Cape Zone Catalogue of 20,843 Stars for Equinox 1900, Zones -40° to -52°. Reduced and prepared for Press under the direction of Dr. H. Spencer Jones. Pp. lxxxiv+140. (London: H.M. Stationery Office.) 26s. net.

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 31st October 1928. Pp. 42. (Newcastle-upon-Tyne.)

Board of Education. Educational Pamphlets, No. 64: Education for Industry and Commerce; a Survey of the existing Arrangements for Co-operation between Industry, Commerce and the Professions and the Technical School System of England and Wales. (Industry Series, No. 1.) Pp. 103. (London: H.M. Stationery Office.) Paper, 6d. net; cloth, 1s. 6d. net.

Empire Cotton Growing Corporation. Report of the Executive Committee, to be submitted to the Meeting of the Administrative Council on October 16th, 1928. Pp. 10. (London.)

Proceedings of the Society for Psychical Research. Vol. 38, Part 108, September. Pp. 103-207. (London: Francis Edwards, Ltd.) 3s.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 23, 1927, No. 2. Pp. clxxxiv. (Calcutta.) 4.8 rupees.

Rubber Research Institute of Malaya. Planting Manual No. 1: Guide to the Preparation of Plantation Rubber. By B. J. Eaton. Pp. iii+54+vii. (Kuala Lumpur.) 2 dollars.

Indian Journal of Physics, Vol. 3, Part 1; and Proceedings of the Indian Association for the Cultivation of Science. Conducted by Prof. C. V. Raman. Pp. 149+5 plates. (Calcutta.) 3 rupees; 4s.

King's College, London. 1829-1929 Centenary Commemoration. Pp. 32+6 plates. (London.)

Survey of India. The Tides. Revised by Major C. M. Thompson. Pp. vi+140+30+50. 2 rupees; 8s. 6d. Professional Paper No. 20: Reconnaissance Survey from Aircraft. By Lieut.-Col. G. A. Beazeley. Pp. ii+34+4 plates. 1.8 rupees; 2s. 6d. Professional Paper No. 21: Irrigation and Settlement Surveys, 1926. By Major J. D. Campbell. Pp. v+36+16 plates. 1.8 rupees; 2s. 6d. (Dehra Dun.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 12, Technological Series No. 7: The Foundations of Yarn-Strength and Yarn Extension. Part i. The General Problem; Part ii. The Relation of Yarn-Strength to Fibre-Strength. By Alfred James Turner. Pp. ii+29. (Bombay.) 1 rupee.

The Hadow Report and After: being a Statement by the Executive of the National Union of Teachers upon certain Recommendations of the Consultative Committee of the Board of Education, and upon the Reorganisation of the Educational System now contemplated by the Board. Pp. 71. (London: National Union of Teachers.) Free.

British Cast Iron Research Association. Seventh Annual Report for the Year ending June 30th, 1928. Pp. 24. (Birmingham.)

A Theoretical Study of the Articulation and Intelligibility of a Telephone Circuit: a Theoretical Study of the Quantities that can be used as a Measure of the Transmission Quality of a Telephone Circuit, and Formulae for determining the Relation between the different Quantities. By John Collard. Pp. 36. (London: International Standard Electric Corporation.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1164 (Ae. 328): Note on the Forces experienced by Ellipsoidal Bodies placed unsymmetrically in a Converging or Diverging Stream. By Dr. H. Lamb. (T. 2617.) Pp. 4+1 plate. (London: H.M. Stationery Office.) 4d. net.

Catalogue of Manuscripts in the Library of the Royal College of Surgeons of England. By Victor G. Plarr. Pp. ii+76. (London.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1926. Pp. v+149. (London: H.M. Stationery Office.) 4s. 6d. net.

Ministry of Health. Regional Water Committees. Pp. 8. (London: H.M. Stationery Office.) 4d. net.



Ministry of Health. Memorandum on the Accommodation for the Sick provided at certain Public Schools for Boys in England. By Capt. W. Dalrymple-Champneys. Pp. 35. (London: H.M. Stationery Office.) 1s. net.

Report of the Eighteenth Meeting of the Australasian Association for the Advancement of Science (Australia and New Zealand). Western Australian Meeting, Perth, August 1926. Edited by A. Gibb Maitland. Vol. 18. Pp. liv+913. (Perth: Fred. Wm. Simpson.)

The British Science Guild. Report of the Committee appointed by the British Science Guild to consider the Reform of the British Patent System. Pp. 48. (London.) 2s.

## FOREIGN.

University of Illinois: Engineering Experiment Station. Bulletin No. 179: An Investigation of Checkerbrick for Carbureters of Water-Gas Machines. By Prof. Cullen W. Parmelee, Albert E. R. Westman and Wilbur H. Pfeiffer. Pp. 90. 50 cents. Bulletin No. 180: The Classification of Coal. By Prof. Samuel W. Parr. Pp. 62. 35 cents. Bulletin No. 181: The Thermal Expansion of Fireclay Bricks. By Albert E. R. Westman. Pp. 30. 20 cents. Bulletin No. 182: Flow of Brine in Pipes. By Richard E. Gould and Marion L. Levy. Pp. 26. 15 cents. Circular No. 17: A Laboratory Furnace for Testing Resistance of Firebrick to Slag Erosion. By Prof. Ralph K. Hursh and Chester E. Grigsby. Pp. 18. 15 cents. (Urbana, Ill.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 171: Farmers' Co-operative Buying and Selling Organizations in Michigan. By C. F. Clayton and J. T. Horner. Pp. 104. Special Bulletin No. 177: The Significance of Soil Variation in Raspberry Culture. By M. B. Hoffman and G. R. Schlubatis. Pp. 20. (East Lansing, Mich.)

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. Vol. 16, pour l'année 1926. Pp. 47. (Copenhagen: Andr. Fred. Høst et fils.)

Reprint and Circular Series of the National Research Council. No. 82: The Physical Causes of Deafness. Report of the Committee on the Physical Causes of Deafness. Part i. Method of Study, by Dr. Charles W. Richardson; Part ii. Statistical Studies of the Children in the Public Schools for the Deaf, by Dr. George E. Schambaugh, assisted by Dr. E. W. Hagens, Dr. J. W. Halderman and Dr. R. W. Watkins. Pp. 100. 1 dollar. Bulletin of the National Research Council. No. 64: The Coroner and the Medical Examiner. Issued under the Auspices of the Committee on Medical Problems. By Oscar T. Schultz and Prof. E. M. Morgan; with a Supplement on Medical Testimony, by E. M. Morgan. Pp. 101. 1.50 dollars. (Washington, D.C.: National Academy of Sciences.)

Department of Commerce: Bureau of Mines. Fuel Briquets in 1927. By F. G. Tryon and J. M. Corse. (Mineral Resources of the United States, 1927, Part 2.) Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 67, No. 2. Pp. 105-197. (Philadelphia, Pa.)

Smithsonian Miscellaneous Collections. Vol. 75, No. 5: Cambrian Geology and Paleontology. V. No. 5: Pre-Devonian Paleozoic Formations of the Cordillera Provinces of Canada. By Charles D. Walcott. (Publication 2965.) Pp. iii+175-368+plates 26-108. (Washington, D.C.: Smithsonian Institution.)

Methods and Problems of Medical Education. (Tenth Series.) Pp. iv+343. (New York City: The Rockefeller Foundation.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 22, Part 1: The Systematic Study on the Formosan Pyralidae. By Jinshichi Shibuya. Pp. 309+9 plates. (Tokyo: Maruzen Co., Ltd.)

University of California Publications in Zoology. Vol. 30, No. 12: Variations in the Fox Sparrow (*Passerella iliaca*) with reference to Natural History and Osteology. By Jean M. Linsdale. Pp. 251-384+plates 16-20. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.85 dollars.

Bulletin of the American Museum of Natural History. Vol. 58, Art. 1: Chinese Fresh-water Fishes in the American Museum of Natural History's Collections. By J. T. Nichols. Pp. 62. (New York City.)

Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 5, No. 2. Pp. ii+127-210-12. (Tokyo: National Research Council of Japan.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandeligen No. 8: Het Klimaat van Nederlandsch-Indië (The Climate of the Netherlands Indies). Door Dr. C. Braak. Deel 2 (Vol. 2), Aflevering 2 (Part 2): Java en Madoera (Java and Madoera). (With English Summary.) Pp. viii+157-399+69-185. (Wetvevreden.)

Verhandeligen der Koninklijke Akademie van Wetenschappen te Amsterdam. Afdeling Natuurkunde (Eerste Sectie), Deel 13, No. 5: Results of Observations of the Total Solar Eclipse of June 29, 1927. 1: Photometry of the Flash Spectrum. By A. Pannekoek and M. G. J. Minnaert. Pp. 106. (Amsterdam.)

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 42: Ensuigata-Rappa no Onkyōgakutekino Seisitu ni tuite (On the Acoustical Properties of Conical Horns). By Satō-Kōzi. Pp. 19. 0.31 yen. No. 43: Theory and Design of a New Carburetor. By Masakiti Isikawa. Pp. 21-67. 0.51 yen. (Tokyo: Kōseikai Publishing Office.)

## CATALOGUES.

No. 445: Old Time Literature (principally XVIIth and XVIIIth Century). Pp. 60. (Cambridge: Bowes and Bowes.)

Imperial Plates for Process Work. Pp. ii+26+7 plates. (London: The Imperial Dry Plate Co., Ltd.)

Bulletin des publications nouvelles. 2<sup>e</sup> Trimestre 1928. Pp. 24. (Paris: Gauthier-Villars et Cie.)

Eastman Organic Chemicals. List No. 19, October. Pp. 87. (Rochester, N.Y.: Eastman Kodak Co.)

Candex Hot Cathode X-ray Tubes. Pp. 8. (London: Cuthbert Andrews.)

Books about Books: Bibliography and Modern Private Presses. (No. 511.) Pp. 77. (London: Francis Edwards, Ltd.)

Scientific and Technical Books: a Classified Catalogue of the Publications of Ernest Benn, Ltd. Pp. 82. (London: Ernest Benn, Ltd.)

## Diary of Societies.

## FRIDAY, NOVEMBER 16.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—V. B. Reader: A Third Factor Present in Marmite, necessary for the Nutrition of the Rat.—H. J. Holman and Prof. S. B. Schryver: The Separation of the Basic Products of the Hydrolysis of Proteins.—J. R. Marrack: Ketosis in Sea-sickness.—Dr. L. J. Harris and T. Moore: Hypervitaminosis.—M. G. Eggleston and P. Eggleston: A Method of Estimating Phosphagen and other Phosphorus Compounds in Voluntary Muscle.—W. J. N. Burch: A Synthesis of Hydroxyglutamic Acid.—W. J. N. Burch and Prof. R. H. A. Plimmer: Esters of Phosphoric Acid.—J. Lowndes and Prof. R. H. A. Plimmer: Bromination of Histidine.—Prof. R. H. A. Plimmer, W. H. Raymond, and J. Lowndes: Comparative Vitamin-B Values of Foodstuffs.—H. Allen, F. Dickens, E. C. Dodds, and F. C. Howitt: A Study of the Oestrus-producing Hormone with Special Reference to its Preparation and Standardisation in Water-soluble Form.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. C. O. Bannister: Some Examples of the Corrosion of Metals.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—E. Windle: The Locomotive Smoke-box.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—T. H. B. Scott: British Cottage Homes.

GLASGOW DYERS' SOCIETY (at 7 Gordon Street, Glasgow), at 7.15.—Dr. S. G. Barker: Some Scientific Aspects of Wool as they affect the Weaver.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. H. Croucher: Some Applications of Time and Remote Control Switches.

TEXTILE INSTITUTE (Lancashire Section) (jointly with Blackburn Textile Society) (at Technical College, Blackburn), at 7.30.—A. Munro: Art, Textile Decoration, and Commerce.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Dr. J. D. Barris and Dr. W. Shaw: Rhabdomyosarcoma of the Ovaries.—Prof. A. Donald and Prof. F. Shaw: Age Incidence in Carcinoma of the Body of the Uterus.—Dr. J. Young: The Prognosis and Treatment of Late Pregnancy Toxemia.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. R. H. Pickard: The Aims of Recent Research at the Shirley Institute.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at Grosvenor Restaurant, Gordon Street, Glasgow).—The "James Watt" Lecture.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Sir William B. Hardy: Short Range Forces.

## SATURDAY, NOVEMBER 17.

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (in Botanical Department, University College), at 11 A.M.—Dr. B. Barnes: The Production of Variations in *Botrytis cinerea* by Heating the Spores.—Dr. W. R. I. Cook: A New *Sorosphaera*.—R. Paulson: The Interpretation of the Microscopic Images of the Gonidium in *Xanthoria parietina*.—Miss Wakefield and W. Buddin: The Fungus causing Carnation Leaf Rot.—S. P. Wiltshire: A Stemphylium Saltant of an Alternaria.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Whittaker: North Country Folk Music (I.).

BRITISH ASSOCIATION OF CHEMISTS (Annual General Meeting) (at Birmingham), at 7.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—P. A. Russell: Shrinkage Holes in Small Grey Iron Castings.

## MONDAY, NOVEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 6.30.—G. R. Bamber: Automatic Combustion Control of Furnaces.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Loughborough College), at 7.—C. K. Speid: Servo Equipment.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in Liverpool University), at 7.—Prof. G. E. Scholes: Combustion.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (Annual Meeting) (at Great Northern Hotel, Leeds), at 7.15.—L. Stanforth: The Costing of Chemical Manufacturing Processes.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—H. B. Booth: British Wools.

HUDDESFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—H. R. Hirst: Textile Defects.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Sir Arthur J. Evans: The Palace of Knossos in the Light of Recent Reconstructions.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. Kidd: Biology and Refrigeration (Cantor Lectures) (II.).

CHEMICAL INDUSTRY CLUB, at 8.—F. E. Hamer: The Recent Visit to America.

ROYAL GEOGRAPHICAL SOCIETY (at Eolian Hall), at 8.30.—Miss G. Caton-Thompson and Miss E. W. Gardner: Recent Work on the Problem of Lake Moeris.

## TUESDAY, NOVEMBER 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (I.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—A. W. Flux: The National Income (Inaugural Presidential Address).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—J. R. Norman: The South American Characid Fishes of the Subfamily Serrasalmoninae, with a Revision of the Genus *Serrasalmus* Lacépède.—Eleanor M. Brown: On a New Species of Microcotyle (Trematoda) from *Pagellus centrodonatus*.—



H. B. Cott: Report on the Zoological Society's Expedition to the Zambesi, 1927.—Dr. C. L. Boulenger and W. V. Flower: The Regent's Park Medusa *Craspedacusta sowerbii*, and its Identity with *C. (Microhydra) ryderi*.—Prof. W. J. Dakin and Marion A. Hamilton: Notes on a naturally occurring Abnormality in the Domestic Fowl, associated with Enlarged Suprarenal Glands.—W. Kew: On the External Features of the Development of the Pseudoscorpiones: with Observations on the Ecdysis and Notes on the Immature Forms.—Oldfield Thomas: On Mammals from the Kaoko-Veld, S.W. Africa, obtained during Captain Shortridge's Fifth Percy Sladen and Kaffrarian Museum Expedition.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. W. E. Dalby: Mechanical Properties of British Rail-Steels.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associates' and Graduates' Branch, Manchester and District) (at Manchester), at 7.—W. Gregg: Fabric Drying.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. H. Lulham: The Spirit of Beauty in Nature and Art.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—L. H. Dawtrey: Automobile Brakes.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering Club, Wolverhampton), at 7.30.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—H. Bull and L. Johnson: The Welding of Stainless Materials.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—A. L. Armstrong: Report on Excavations in the Pin Hole Cave, Cresswell, and the Recent Discovery of an Engraving of a Masked Human Figure.

### WEDNESDAY, NOVEMBER 21.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. F. J. W. Whipple: On the Association of the Diurnal Variation of Electric Potential Gradient in Fine Weather with the Distribution of Thunderstorms over the Globe.—N. K. Johnson: Atmospheric Oscillations shown by the Microbarograph.—H. Jameson: On the Mean Maximum Rain falling in a Time  $t$ .

EUGENICS SOCIETY (at Royal Society), at 5.15.—Dr. F. C. S. Schiller: Eugenic Reform of the House of Lords.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—F. G. Shotton: The Geology of the Country around Kenilworth (Warwickshire).—Dr. Stanley Smith and Prof. S. H. Reynolds: The Carboniferous Section at Cattylbrook, near Bristol.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at Iron and Steel Institute), at 5.30.—E. Wyndham Hulme: Statistical History of the Iron Trade, A.D. 1717-1765.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—H. G. Cousins: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—C. W. Salt: Address.

ALCHEMISTS' SOCIETY (in Chemistry Lecture Theatre, University of Glasgow), at 7.30.—Prof. J. Read: The Chemical Interest of Essential Oils: Some Research Experiences.

BURNLEY TEXTILE SOCIETY (at Oddfellows' Central Club, Burnley), at 7.30.—J. W. Pennington: Drawing and Twisting.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College), at 7.30.—B. P. Hill: Impressions of some Canadian and American Industries.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—W. D. Sheers: Electric Trams v. Motor Buses.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Miss Kathleen M. Carter: Ovule Development and Meiosis in *Orobancha minor*.—Dr. W. H. Van Seters: Tripod and Pillar Microscopes.

ROYAL SOCIETY OF ARTS, at 8.—Sir Gerald Bellhouse: Safety in Factories.

FOLK-LORE SOCIETY (at University College), at 8.—S. G. Roberts: Tamil Proverbs in the Folk Stories of the late Natësa Sästri, M.F.L.S.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—S. Field: Presidential Address.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—A. J. Croft: Steel Works.

### THURSDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. D. Adrian: The Mechanism of the Nerves (I).

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.—R. C. Moon: Notes on a Storm Water Pumping Plant.

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with British Institute of Radiology), at 6.—L. G. H. Sarsfield: The Electrical Equipment of X-Ray Apparatus.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Major T. M. Barlow: Weight of Aircraft.

INSTITUTION OF STRUCTURAL ENGINEERS, at 6.30.—Recent Improvements in the Strength and Constructive Value of Portland Cement.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (Annual Meeting) (at Essex Hall, Strand), at 8.—Dr. Marie Stopes: Details from 10,000 Birth Control Cases (Presidential Address).

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.), at 8.30.—Dr. L. A. Weatherly: Juvenile Psychologic Delinquencies—their Origin and Treatment.

### FRIDAY, NOVEMBER 23.

ANATOMICAL SOCIETY OF GREAT BRITAIN AND IRELAND (Annual Meeting) (in Anatomy Department, King's College), at 3.—J. H. Mulligan: Complete Absence of Corpus Callosum in Human Brain.—Prof. C. J. Fatten: The Mechanism involved in the Technique of Bird Utterances.—Dr. A. B. Appleton: An Example of the M. Cervico-costohumeralis (Gruber).—C. P. G. Wakeley: A Note on the Architecture of the Ilium.—Dr. R. J. Gladstone: The Origin of the Vena Azygos Major.—Dr. V. E. Negus: The Function of the Cartilage of Santorini.—Dr. F. W. R. Brambell: Histology of the Gonads of an Hermaphrodite Pig.—Dr. D. M. Blair: Note on Submaxillary Lymph Glands.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr. H. M. Mackay: Nutritional Anemia in Infancy.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. Temple: The Physical Interpretation of Wave Mechanics.—A. Monkhouse: The Effect of Superimposed Magnetic Fields on Dielectric Losses and Electric Breakdown Strength.—A. Campbell: A New Potentiometer of Larson Type.—Prof. E. F. Herroun and Prof. E. Wilson: Ferro-magnetic Ferric Oxide.—Demonstration by R. H. Humphrey of Emulsions showing Chromatic Effects.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. C. H. S. Evans: Searchlights and their Applications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Manchester Association of Engineers) (at Manchester), at 7.—R. Brooks: Electric Traction on Railways.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Tornblad and Mitchell: Hartmann Spiral Bricks.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—C. F. Moore: A Survey of Cadmium.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—R. Brooks: Electric Traction on Railways.

### SATURDAY, NOVEMBER 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Whittaker: North Country Folk Music (II.).

### PUBLIC LECTURES.

#### FRIDAY, NOVEMBER 16.

KING'S COLLEGE, at 8.—Prof. A. R. Ling: Contributions to the History of Starch and its Transformation Products (Streetfield Memorial Lecture).

#### SATURDAY, NOVEMBER 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: "Missing Links" and Evolution.

#### MONDAY, NOVEMBER 19.

UNIVERSITY OF LEEDS, at 5.15.—R. H. Fowler: Some Applications of the New Quantum Mechanics.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—J. B. Ormond: The Cultivation of the Cricket Bat Willow.

#### TUESDAY, NOVEMBER 20.

KING'S COLLEGE, at 5.30.—Miss H. D. Oakley: Aristotle's Idea of Deity.

GRESHAM COLLEGE, at 6.—Sir Robert Armstrong-Jones: Physic. (Succeeding Lectures on Nov. 21, 22, and 23.)

UNIVERSITY OF LEEDS (in Philosophical Hall, Leeds), at 8.—Prof. A. C. Hardy: The Work of the R.R.S. *Discovery* in the Sub-Antarctic Regions.

### WEDNESDAY, NOVEMBER 21.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Thomas Oliver: Lead Poisoning in Industries.

MEDICAL SOCIETY OF LONDON (11 Chandos Street, W.), at 5.15.—Dr. E. P. Cumberbatch: Physio-Therapy, with special reference to Medical Electricity (Chadwick Lecture).

KING'S COLLEGE, at 5.30.—Prof. E. V. Appleton: The Indebtedness of Industry to Pure Science: Electrical Communication and its Indebtedness to Physics.

UNIVERSITY COLLEGE, at 5.30.—W. C. B. Sayers: A Modern Public Library at Work.

#### THURSDAY, NOVEMBER 22.

GUILDHALL, BATH, at 8.—Dr. E. P. Cumberbatch: Physio-Therapy, with special reference to Medical Electricity (Chadwick Lecture).

UNIVERSITY COLLEGE, at 8.15.—Miss M. A. Murray: Art and Architecture of Ancient Egypt. (Succeeding Lectures on Nov. 29 and Dec. 6.)

#### FRIDAY, NOVEMBER 23.

KING'S COLLEGE, at 5.30.—C. J. Gadd: Assyrian Studies in the Past.

#### SATURDAY, NOVEMBER 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Mummies.

### CONGRESS.

#### WEDNESDAY AND THURSDAY, NOVEMBER 21 AND 22.

INSTITUTE OF FUEL (at Institution of Electrical Engineers).

Wednesday, Nov. 21.

At 10 A.M.—Lord Melchett: Presidential Address.—Sir Henry Fowler: Fuel Conservation in Locomotive Practice.

In Afternoon.—Economics of Coal Production and Distribution.—G. Raw: Production.—Prof. H. Louis: Preparation.—Capt. R. Ardy: Marketing.

Thursday, Nov. 22.

At 10 A.M.—Dr. F. Münzinger: Electric Power Stations.—Dr. E. S. Grumell: The Chemical Industry.—A. J. Dale and A. T. Green: Ceramic Industry.—Dr. Geoffrey Martin: The Cement Industry.—T. A. Peebles: American Practice and Experience.—J. R. Edwards: Practical Results of Fuel Control.

In Afternoon.—M. J. Conway: Liquid Fuel in Open-hearth Practice.—J. L. Bentley: Fuel Control in Open-hearth Practice.—H. C. Armstrong: Fuel Control in Reheating Furnaces.—J. B. Fortune: Fuel Control in Blast-furnace Stoves.