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Education by Radio.

INFORMAL instruction, which need be neither illogical nor discrete, nor even so completely popularised in its presentation as to lack essential accuracy of fact and deduction, is perhaps as vital a force in the cultural development of a nation as its formal educational system. The new power of the broadcast message gives to the world a new university without matriculation and, what is perhaps more attractive, without examinations; a university the teaching of which is not only extra-mural but is also offered as a free gift to anyone who cares to go to the trifling expense and trouble of accepting it. As such it is in no sense a competitor with schools and colleges, nor ever can be; indeed, its success in Great Britain has been largely due to the co-operation which has been forthcoming from professional educators and their institutions.

In the United States of America the evolution of radio broadcasting has permitted a regular collaboration between the University of Pittsburgh and the radio station KDKA of the Westinghouse Electric and Manufacturing Co., a collaboration which has now completed four years of public service. Education by radio has its limitations and its pitfalls, as well as its attractions, and those responsible for these series of lectures have done well to emphasise that arm-chair listening forms no short cut to knowledge and culture, although it may add in no small measure to the sum of human happiness by providing mental stimulus, and widening vision of some of the less tangible matters of moment. Nothing can adequately function as a substitute for the influence of mind upon mind that comes of personal contact, but broadcasting at least provides a kind of one-way traffic which may well awaken response in many hundreds of thousands of minds which would otherwise be denied the opportunity of guidance towards thought extending beyond their immediate affairs.

The possibilities of this social service are, in fact, so vast that it would be as profitable at this stage to attempt to lay down rules for its development, or even to comment in detail on what has already been accomplished, as it would have been in Caxton's day to specify the contents and format, or to review the influence, of printed books. As an example, however, of the scientific side of the service, as offered outside Great Britain, we may briefly describe the contents of four booklets reproducing talks delivered by research specialists of the Mellon Institute of Industrial Research

under the auspices of the Pittsburgh collaborative scheme.

In "Science and Industry" (Radio Publication, No. 9) there are seven talks on such subjects as iron and steel, natural gas, petroleum, coal and coke, glass, and clay products; "Science in the Home" (No. 23) includes eleven talks on foods and food values, beds, fuel, textiles, disinfection, utensils, and structural materials. "Automobile Engines" (No. 28) formed the subject of six talks, which were doubtless appreciated by many thousands of motorists whose knowledge of the 'how and why' may previously have left something to be desired, whilst the seven talks on "Wearing Apparel, its Manufacture, Utility, Selection, and Care" (No. 37), must have appealed to an even wider circle. The list contains references to series of talks on "Conversations with a Philosopher," "Evolution and Heredity," "American Foreign Policy," "The Naturalist Afield," "Man and the Earth." The technical lectures mentioned form, of course, only one aspect of the educational edifice, and equally good use is being made elsewhere of similar opportunities for public service; but we feel that the enterprise of the University of Pittsburgh and the Westinghouse Company deserves both congratulation and encouragement.

A Directory of Specialised Information.

The Aslib Directory: a Guide to Sources of Specialised Information in Great Britain and Ireland. Edited by G. F. Barwick. Introductions by Sir Frederic G. Kenyon and Sir Ernest Rutherford. Published with the Financial Assistance of the Carnegie United Kingdom Trustees. Pp. xiv+425. (London: The Association of Special Libraries and Information Bureaux; Oxford University Press, 1928.) 21*s*. net.

TRULY has it been said, "Of making many books there is no end." It is, however, a curious reflection on the perspicacity of the human intellect that mankind should continue to groan at the weariness of much study, while making so little effort to diminish the burden, either by attempting to limit the rate of increase of material, or by considering how to improve the method of handling it.

> "'Tis pleasant sure to see one's name in print,
> A book's a book although there's nothing in't."

So the world's production continues to be mostly in books.

Recently in Great Britain a serious attempt was made to estimate the magnitude of this output. From the "World List of Scientific Periodicals" we learnt that scientific and technical information has been published during the present century in some twenty-five thousand periodicals, besides separate books. Perhaps, of these periodicals, some fourteen thousand of those now current may contain useful matter. If then we might make a guess, that the average annual number of separate articles in a scientific journal is of the order of one hundred, the total yearly output of scientific papers might be taken as about one million or more. Thus at least we know now, that in order to find what information has been published on a given subject, we have to sort and index each year a million articles or notices published in periodical literature in addition to works issued separately. How to accomplish this task is a problem that must be solved, unless we are content to allow much of this tremendous volume of useful information to run to waste for ever.

It has been shown elsewhere that one solution of the problem is the general adoption of a standard classification, so that all those engaged in indexing information may join in a common movement for the common good. Now, it has been calculated that there are, in the Science Library at South Kensington alone, some forty million published bibliographical notices. So that the total number of published index-titles appears to be comparable with the total number of scientific papers issued. To produce a comprehensive index, therefore, requires merely the organisation of a quantity of energy, comparable with that which is now being expended uneconomically in isolated bibliographical efforts.

The work under notice makes a further contribution to the diagnosis of the extent of the malady. It does not profess to cure the evil. There exist, in Great Britain alone, some thousands of agencies, working by multifarious methods, for the purpose of collecting books or information on special subjects. The "Aslib Directory" is a worthy attempt to make a list of such agencies, and serves to indicate the vast amount of labour that is actually being expended in collecting information. While fully appreciating the value of this important contribution to bibliographical data, it is necessary to take exception to some remarks in the introduction to the work. After referring to the object of the Association of Special Libraries as being "to serve the need of the research worker," and adverting to similar organisations abroad, the introduction goes on to say "the fear is some-

times expressed that all this complex machinery may defeat its own end. The universal bibliographies which some desire are likely to break down through their own weight. The bulk of such work would be crushing, its ramifications bewildering; it is almost impossible that it should be up to date, and the research worker is in danger of being delayed as much as he is helped by it. From this danger the present Directory, so far as I can judge, is free. It is not a bibliography of universal knowledge, but merely a guide to tell the worker where special collections dealing with his subject are to be found. There he can search for the special bibliographies of his subject, *if* he needs them." The italics are ours.

It is a pity that there should be a misunderstanding of the aims of those who are seeking, by making the best use of the energy available, to produce a workable index to the information which is now lying buried and useless on the library shelves. As has been seen above, the bulk of such an index would be no greater than that of the present bibliographical output; its ramifications would be reduced to a single system, and it would be as up-to-date as the printing press. The Director of the research laboratory of a large industrial organisation, Dr. Mees, says, in his "Organisation of Industrial Scientific Research": "It should certainly be possible for large libraries to keep such numerically indexed files [of all science] to which reference could be made by correspondence by any research worker." If scientific men consider such an index to be desirable, or even necessary, are they not entitled, after having made an exhaustive study of the question, to decide whether or not it is possible? At any rate, the authors of the undertaking are determined to see it through.

However, the work under review must be judged on its merits, apart from any misunderstandings on the question of principle. The Directory brings to the notice of those in search of information, collections of material, whether in print or manuscript, of the existence of which they may be unaware. The arrangement is alphabetical, according to the selected name of the subject considered. Such a system is not unsuited to the classification of a comparatively small range of subject-headings, and enables the collections relating to a given subject to be found with ease. The editors are to be congratulated on the mass of material that they have been able to gather into their inventory. The collection is necessarily incomplete in a first edition, and apparently the editors have been hampered by the need of completing the volume within a given time. But undoubtedly much care has been bestowed on the compilation of the work, and it will be indispensable to all those who are interested in the supply of, or research for, information.

Without wishing to detract from the considerable merit of the publication, a few words of criticism are necessary. A certain lack of proportion is evident in the number of items catalogued under the different headings. For example, the information gathered under the heading "Postage Stamps" occupies 81 lines, and includes twelve periodicals; while that under "Zoology" extends to only 57 lines, without indicating any periodicals. The "Zoological Record" appears to have been omitted. Incidentally, why should scientific periodicals be referred to as "Press"? Some of the entries are even more extraordinary. The section on "Bibliography" comprises only fourteen entries, which include no more than two periodicals, and reference is made to the million cards on a single system of the Subject-matter Index at the Science Library merely as "An extensive collection of bibliographies." Under "Periodicals" the only collection catalogued is the "Loan Library of Periodicals indexed in the Subject Index to Periodicals" of about two hundred and fifty sets dating from 1915 onwards. No mention whatever is made of the great collections in the National Libraries, which include many thousands of complete sets of periodicals. Some imperfections are inevitable in the first edition of a work of this magnitude, and it is to be hoped that in future editions it will be possible to remove such blemishes.

S. C. BRADFORD.

Theoretical Astrophysics.

Astronomy and Cosmogony. By Sir J. H. Jeans. Pp. x+420+16 plates. (Cambridge: At the University Press, 1928.) 31*s.* 6*d.* net.

SINCE the beginning of our present era, astronomy has been considered to be the foremost of exact sciences, and there can scarcely be any doubt that the idea of law and order in the linking of natural phenomena was first forced upon the dawning mind of man by the regular march of the stars. In the course of time, however, astronomical theory has been left behind by the rapidly increasing wealth of observational data to such an extent that present-day astronomy must largely be classified among the descriptive sciences, in

spite of the triumphs of celestial mechanics and the arduous work done during the last fifteen years to raise *theoretical astrophysics* to the rank of a separate science. Astronomy is therefore more than ever a promising field for theoretical research, and Sir J. H. Jeans's book, which aims at summarising the present status of the young science, will undoubtedly provide inspiration to theoretical astrophysicists; at the same time it will encourage astronomers doing observational routine work to make enhanced efforts, and will disseminate the knowledge of modern astronomy among workers in allied sciences.

The division of the book in principal sections is not quite so clear as might have been desired, but there is no difficulty in distinguishing three main parts. First, there is naturally given a summary and survey of salient facts in astrophysics. Next comes a series of chapters on various subjects which, essentially, give an outline of the conceptions and points of view which play the principal part in the later theoretical deductions. The rest of the book, which is its main part, is devoted to stellar theory. First the constitution of individual stars is considered, and after that the interrelationship between the stars as we pass through groups of increasing complexity from binary stars and moving clusters, to the Milky Way system, globular clusters and extra-galactic nebulæ.

The introductory chapter on empirical astrophysical facts is exceedingly well written, and displays Jeans's admirable style in full force. There is one point, however, where I believe that a more detailed account would have been advantageous. This is in the representation of the Russell diagram, which has been the starting point as well as the stumbling stone of several cosmogonic theories in the short time which has elapsed since it was first given. That this diagram does not give an adequate picture of the abundance of stars of given spectral characteristics in space, is universally recognised. Thus it is known that dwarf stars outnumber the giants by hundreds or thousands, while the Russell diagram of all stars with known luminosity conveys the impression that giant stars predominate.

The diagram given by Jeans, however, involves other effects of observational selection as well. Thus, apart from the *B*-stars, which all belong to the moving clusters in Orion and Scorpius-Centaurus, the absolute magnitudes are derived exclusively by spectroscopic methods. Due to the difficulty of extending this method to stars of early type the diagram contains only *two* stars in the interval *A*0 to *A*5, while the total number of stars considered is 2100. This may be confronted with the fact that in the stellar system *every third or fourth star is an A-star*. It should further be noted that the high luminosity *F*- and *G*-stars, forming a conspicuous peak in the diagram, are selected *just* on account of high luminosity, since they are all Cepheids or pseudo-Cepheids, while the congestion of giant stars in the interval *K*1 to *K*6, according to the Mount Wilson report from which the diagram is reproduced, is partly due to imperfections in the underlying system of spectral classification. Moreover, all data derived from ordinary parallax work, as well as from the work on spectroscopic parallaxes after 1921, are neglected. It seems, on the whole, difficult to draw any trustworthy conclusions from this diagram about the relative abundance of giant stars of given luminosity but different spectral class.

As regards the internal constitution of the stars, it is clear from the outset that most conclusions must be highly conjectural in nature. It is therefore no wonder that hitherto it has been possible to enlist unanimous assent only for two main conclusions concerning conditions in the stellar interior, namely, that the temperature must average some millions of degrees, as a consequence of which the atoms must be largely dissociated into free electrons and very compact positive ions. Apart from these general results, opinions differ widely, and Jeans in particular has held and holds views which some other astrophysicists are reluctant to accept. In such circumstances it might have been a good plan, in writing a book for the general reader, to give the various ideas as impartially as possible, so as to give a fair impression of the present unsettled state of the subject. Jeans, however, has adopted the easier procedure of developing his own personal views, and in doing so he has succeeded in representing his ideas in the form of an imposing cosmogonic system.

A cornerstone in Jeans's cosmogony is the assumption that stellar substance is more like an incompressible liquid than a gas. It has not been possible thus far to make this idea plausible on the basis of atomic theory, and until this question is settled in a satisfactory manner the liquid star theory must be received with reserve. Jeans, however, does not consider the disagreement in question as serious, and believes that the criticism which may be adduced against the theory from

the side of atomic physics is more than counterbalanced by the success it experiences in astrophysics.

The suggestion in question was first brought forward in an investigation of the stability of a gaseous star. Making certain special assumptions concerning the mode of generation of energy in a star, Jeans found that gaseous stars are likely to be secularly unstable, and hence that stars which actually exist must involve substantial departures from the ideal gas laws. Following up this question further, Jeans believes he has found corroborative evidence for the same conclusion in the striking form of the particular Russell diagram which was commented upon earlier in this review. In Jeans's interpretation of this diagram the blank spaces correspond to states of the stellar matter in which particular electronic shells are in a process of disintegration. The blank lower left part of the diagram corresponds to the K-shell being in a disintegrating state, while the lack of giant A and K stars corresponds to a breaking down of the L- and M-shells respectively. As emphasised above, it would seem, however, that it is doubtful whether the empirical data in hand really warrant conclusions of this kind.

A further argument in favour of the liquid star theory is given by the surprisingly large number of close binaries found among early type stars. In fact, admitting the stars to be of uniform density and to rotate with a constant angular velocity, it follows from the classical researches of Poincaré, Darwin, Jeans, and others, that duplicity may, in the case of close binaries, be due to fission by rotational instability. In this way the liquid star theory is linked on to the main part of Jeans's cosmogony, which is based largely on the effect of rotation on stellar evolution. How this is carried out in detail is probably well known from his book, "Problems of Cosmogony and Stellar Dynamics," which was published nine years ago, and is largely reprinted in the present volume.

In the intervening time the theory has received an interesting addition in the discovery by Jeans two years ago that light pressure will exert a braking effect on a rotating star, such as to make its outer layers move with less angular velocity than the inner layers. Invoking this effect, Jeans has tried to explain some problems which hitherto have appeared to be intractable, such as Cepheid variability, or the equatorial acceleration of the sun. It is probably too early to say definitely whether the importance which Jeans attaches to this effect will be fully justified or not, as there are other agencies as well which may tend to produce a space variation of angular velocity in a rotating star. Thus, unless the heating sources in the star are distributed in a very special way, they must set up powerful convection currents which in turn must produce a variable angular velocity.

It is very difficult to arrive at a definite view of Jeans's theory of stellar constitution. I fear, however, that few theoretical astrophysicists will be able to share in Jeans's optimism concerning the future of the liquid star theory. It should be fully realised that atomic theory points the other way, and that most of the observational arguments brought forth in its support are open to alternative interpretations. Moreover, the considerations concerning stellar stability given by Jeans would seem to need considerable refinements before being accepted as final.

It is not possible to close this review without mentioning the last chapters on the great nebulæ, the galactic system, and the origin of the solar system. The chapter on nebulæ, in particular, is admirable with regard to style as well as carefully balanced poise of judgment on difficult points. In these days, when the island universe view of the spirals is so widely discussed, it is well to have brought to mind in an impartial manner the arguments in favour of this idea, as well as the serious difficulties opposing the view that an average spiral nebula is in all details comparable to the galaxy. In the chapter on variable stars Jeans brings forward some novel ideas regarding the origin of Cepheid and long-period variability based on the braking effect of light pressure in rotating stars. The ideas are evidently still in a nascent state, but even so they may serve the good purpose of breaking the deadlock encountered by the strict pulsation theory.

I have the feeling that the greatest value of this book lies in the vistas it opens up to workers in theoretical astrophysics. Intense work on special problems frequently narrows down the field of vision. But here is a book written by an active scientist whose mind is first of all focused on problems of the widest bearing. On the other hand, it cannot be overlooked that the style frequently has an apodictic turn which ill suits the intangible nature of the problems in hand, and it is no diversion to see the summary judgment with which the work of others is sometimes dismissed or ignored. The following example will indicate the seriousness of this remark: The energy

equation lying at the base of Jeans's investigation of pulsational stability is the obvious equivalent of v. Zeipel's theorem, which Jeans believed to have disproved some years ago. But I fail to find a frank recognition of v. Zeipel's work, and Eddington's interpretation of it, with its consequent importance for the problem of stellar rotation. Still more bewildering: at another place (p. 79) Jeans seems to adhere to his original statements! And instances like this might have been multiplied. This aloofness with which the work of other investigators is treated I consider to be an essential weakness of the book, and to make it less suited as a text-book for the uninitiated reader.

It was recognised long ago as a fundamental principle of literary criticism that in order to understand thoroughly a work of art it is necessary to be familiar with the mentality and history of its author. In the case of scientific literature this fact is mostly lost sight of, as it is expected that the odds and ends of the work will appear explicitly in the text and be justified by rigorous arguments. This, however, is more an abstract ideal than a reality. Anyway, in the case before us the personal views of the author pervade the book to such an extent that, besides being a work of science, it must be considered also as a work of art.

S. ROSSELAND.

Mantell of the Weald.

Gideon Algernon Mantell, LL.D., F.R.C.S., F.R.S., Surgeon and Geologist. By Sidney Spokes. Pp. xv + 263 + 7 plates. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 12*s.* 6*d.* net.

GIDEON ALGERNON MANTELL is one of the group of medical men to whom early British geology was so greatly indebted. Their training in anatomy, which was then less restricted than at present to human anatomy, enabled them to interpret fossils and lay the foundations of British palæontology. Mantell, who came of an old Sussex family, had an extensive and successful practice at Lewes. In the intervals of his work he made the first important collection of fossils from the Weald, and is credited by Lyell with having established the freshwater origin of the Wealden formation. His own conclusions as to some of the fragmentary fossils were more correct than those of the best-trained anatomists of his day. Thus he discovered in the Weald, among other important fossils, some teeth and bones of the animal which he called the Iguanodon; he correctly identified it as a colossal herbivorous reptile, whereas Cuvier insisted that the remains were those of the hippopotamus and rhinoceros. Mantell also collected many of the fishes from the Chalk that were described by Agassiz. Sir John Flett, in his preface to the recent Geological Survey Memoir on the geology of the country near Hastings and Dungeness, remarks, "Special mention may be made of Gideon Mantell and W. H. Fitton, whose researches are among the classics of geology."

There has been no adequate account of Mantell's life or appreciation of his scientific work, though his name is gratefully remembered by many fossil collectors who owed much to the guidance of his "Medals of Creation," and his collection, now in the British Museum (Natural History), remains one of the most important contributions to Wealden geology. Mr. Spokes has done a valuable service by this biography of Mantell, especially by the publication of many letters to Benjamin Silliman of Yale, which give an illuminating account of contemporary geologists and throw interesting sidelights on early Victorian conditions. Thus he referred to the Prince Consort, whom he met several times at social-scientific functions and to whom he showed his microscope, as unpopular in society because the Prince preferred the company of men of intellect to that of dukes and marquises; and he deplored the inevitable deterioration of the Prince's fine mind by compulsory attendance at races and the influence of the turf.

Mantell's career was strenuous and his life in some respects unfortunate. Mr. Spokes is candid about Mantell's defects, and represents him as vain and querulous, and constantly aggrieved by what he regarded as intentional slights. His anger with Owen was not unjustified; but his comments on others are to his disadvantage. Thus Lyell, who was then laying the foundations of modern Kainozoic stratigraphy, visited Mantell at Clapham: Mantell remarked that "Lyell, as usual, was too absorbed in miocene, pliocene, plistocene (*sic*), etc., to care for any other 'scenes,'" and that "this tomfoolery would serve to amuse the geologists for six months." These statements show that Mantell was either blinded by what Mr. Spokes calls his jealous "obsession," or by his limited insight into the fundamental principles of geology. His happiest time was when in practice at Lewes; he made then his most important discoveries; he was entrusted by Murchison with the description of the famous "fossil fox of Oeningen"; he made the collection

which was his chief permanent contribution to science; he then gained among his fellow geologists the title of "the Wizard of the Weald"; while his reputation amongst the Sussex quarrymen is quoted by Lyell, who was directed to him as "a monstrous clever mon, as lived in Lewes, a doctor, who knowed all about them things, and got curosities out of the chalk-pits to make physic with."

This connexion of fossils and medicine was not felt in the communities where it might have helped Mantell. Mantell's growing ambitions led him to move from Lewes to Brighton, which was then a seat of the Court, and would, he hoped, provide a more aristocratic and lucrative practice. The medical men in Brighton were jealous of him, and the impression was spread around that no man could have gained such a scientific reputation without neglect of his patients and medical studies. Mantell's Brighton venture was a disastrous failure. His museum drew crowds of visitors; he was a success socially and as a popular scientific lecturer; but he had no patients, and after he had spent his savings he had to sell his collections to the British Museum for £4000. He settled in Clapham Common, and there was more successful financially. To avert the suspicion that he was not interested in medicine, he made many contributions to the medical journals, and his frequent expression of orthodox religious sentiments may have been partly issued in his professional interests. He afterwards moved to Pimlico, where he practised until his death.

Mantell's popular reputation was due to his skill as a lecturer and writer. His "Wonders of Geology" did much to interest his generation in the subject, and his "Medals of Creation" inspired many of the fossil collectors, from whom geology has enlisted a high proportion of its recruits. His permanent contributions to the geology of south-eastern England were, however, of first-rate importance, and the confirmation of the chief conclusions which he drew from the fragmentary reptilian remains of the Weald by the complete specimens discovered in Belgium and the United States show his sound anatomical insight. He was deeply hurt by being ignored on the foundation of the Palæontographical Society and wrote to Silliman: "I must be content to throw a few pebbles into the ocean of truth, and pass away from this scene of trial and suffering unremembered and unregretted save by a few valued friends." Mantell's place in British geology is far higher than he foresaw.

Power Engineering.

(1) *Applied Heat.* Adapted from "Der Wärmeingenieur" by Julius Oelschläger under the Editorship of Dr. H. Moss. Pp. x + 334. (London and Glasgow: Blackie and Son, Ltd., 1927.) 30*s*. net.

(2) *Les turbines à vapeur: traité à l'usage des ingénieurs, des techniciens et des élèves ingénieurs des écoles d'application.* Par Prof. Giuseppe Belluzzo. Traduit de l'Italien par Jean Chevrier. Deuxième édition entièrement refondue. Tome 1: *Théorie et calcul des turbines à vapeur.* Pp. xviii + 367 + 2 planches. 60 francs. Tome 2: *Les turbines à vapeur.* Pp. viii + 596 + 16 planches. 80 francs. (Paris: Gauthier-Villars et Cie, 1927.)

(3) *Applied Thermodynamics: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E., and A.M.I.Mech.E. Examinations in this subject.* By William Robinson. (Engineering Degree Series.) Pp. x + 564. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 18*s*. net.

(4) *Thermodynamics Applied to Engineering.* By Arthur F. Macconochie. Pp. xiv + 260 + 13 plates. (London: Longmans, Green and Co., Ltd., 1927.) 12*s*. 6*d*. net.

(5) *Les moteurs à courants alternatifs, les moteurs d'induction, les moteurs à collecteur: théorie, calcul, construction, applications.* Par Louis Lagron. (Nouvelle Encyclopédie Électromécanique, No. 2.) Pp. 429. (Paris: Albert Blanchard, 1927.) 25 francs.

(1) HEAT energy derived from the combustion of fuel is still the main source of mankind's energy supply, and it must be admitted that the world demand for energy increases year by year. It is important, therefore, that the utilisation of the available fuel should be conducted in the most efficient manner. In translating and adapting "Der Warmeingenieur," Dr. Moss has made available to English readers a most useful survey of the principal uses to which heat energy is applied, and one in which particular attention has been paid to the efficiency of the processes described. To make the work suitable for British engineers, Dr. Moss has found it necessary to effect considerable revision.

The book contains sections on natural and artifically prepared fuels, the principles of combustion, and their application to various forms of furnaces and burners, using all types of fuel. Chapters are included on the utilisation of heat for heating purposes and also for power purposes, but

in view of the literature otherwise available, the power section is relatively condensed. The concluding chapter deals with heat balance and energy measurements, and is a valuable feature. Another good feature of the book is the quantitative treatment of the chemical and heat reactions discussed.

The descriptive matter in the book is supplemented by ample data, and numerous tables and formulæ are provided. The book may be regarded to some extent as an encyclopædia of applied heat, which may be profitably consulted by engineers, metallurgists, and others desirous of improving the efficiencies of plants involving the application of heat. It is attractively arranged, the illustrations are excellent, and altogether we have much pleasure in welcoming its publication, which fills an obvious gap.

(2) Prof. Belluzzo's work on steam turbines, translated by M. Chevrier, is in two volumes. The first volume deals with the steam turbine from the theoretical and heat engine point of view; the second volume is mainly reserved for the mechanical principles and details of construction. The work is a large scale one, reminding one to some extent of Prof. Stodola's well-known book.

In the first chapter of Vol. 1 a good deal of information is given about the heat properties of water and steam. As a reminder that nothing is final, this is a good thing, but we could not help feeling that post-War work on this subject is scarcely mentioned. Possibly the author feels that more information is necessary. Incidentally there is little mention of Callendar. The treatment of flow in nozzles follows standard lines, but the subject of supersaturation is only dealt with briefly. In the account of experimental researches on the flow of vapours, work done on the Continent is plentifully adduced, but valuable work done in Great Britain is almost ignored, and there is no reference to the labours of the Steam Nozzles Committee of the Institution of Mechanical Engineers. We should add, however, that we were attracted by some of the chapters, for example, on general principles of turbine calculations, on partial admission, and particularly on frictional losses.

In Vol. 2 we have a large mass of information which is well arranged, and, generally speaking, this half of the treatise appealed to us more than Vol. 1. The mechanical problems involved in drums, discs, whirling shafts, etc., are treated at some length, and the theory of the Michel bearing is given. There is also a good account of the application of turbines to marine work, and a short section on the application of turbines to locomotives. Although the constructions described refer mainly to Continental practice, this should be an attraction to English readers.

The illustrations and drawings are good, and some of the latter are dimensioned, but we deplore the absence (familiar in French books) of an index. The price is small for such a large work, and should tempt many engineers in Great Britain to buy it.

(3) Prof. Robinson's book on applied thermodynamics is intended as a text-book for engineering students and engineers studying heat engines, and is designed to cover the syllabuses in applied thermodynamics of certain well-known examinations. An important feature is the constant reference to laboratory work and modern research (with references), side by side with fundamental principles. Plenty of worked-out examples are given, and at the end of each chapter there is a good selection of examples, the answers to which are given.

In a book like this, covering such a wide range of subjects, Prof. Robinson has to exercise a large discretion as to the relative importance to be attached to individual subjects. Thus he gives an interesting chapter on internal combustion engines, extending to 145 pages. On the other hand, the chapters on nozzles and turbines are comparatively short. Possibly the latter chapters will be lengthened in later editions. We should also like to see a short reference to steam-condensing plant. Another minor criticism; we failed to find any reference to exhaust calorimeters in the chapter on internal combustion engines. We regret this, as there is educational value in a good heat balance sheet, which may cause students to ask questions like: "How is piston friction to be treated?"

The book is excellently produced, and we are quite sure that it will be a most useful and popular text-book for engineers.

(4) In his preface, Prof. Macconochie states that his purpose is to present the principles of engineering thermodynamics in the simplest fashion, to illustrate these principles by the best British and American practice, and in selecting examples for illustration to lay stress on recent developments likely to make a strong imaginative appeal. The book thus differs from many other text-books, in that whilst giving the main principles of heat engine theory, it only goes into the details of a comparatively few plants. The method has its advantages, particularly for the student who wants to get a fairly quick survey of the subject, and wants the

detailed work to be in the main stream of present-day progress. On the other hand, a writer using such a method is liable to omit material which other people may think important. However that may be, the practical examples chosen for illustration are interesting enough; they include, *inter alia*, turbine plants for mercury vapour and steam, the uniflow engine, the Westinghouse impulse reaction turbine, the two-stroke Diesel engine, the gas turbine, and the exhaust gas turbine.

The descriptive matter is accompanied by 13 photographic plates, which should help students to visualise the items dealt with. Among the tables of heat properties of vapours at the end of the book there is included one for mercury vapour. Two Mollier charts are also provided, one for ammonia, according to the U.S. Bureau of Standards, the other for steam. The latter goes up to 750 lb. per sq. in., and 800° F. Worked examples are given, but we think students would appreciate answers to the examples set for practice. Other problems are stated under the heading (somewhat unfamiliar to English engineering books) of "topics for discussion." The theoretical work is clear, and the whole book is very readable. We surmise that Prof. Macconochie, being at the University of Virginia, has naturally had in mind the needs of American students, but his book has many features of interest for British students and engineers.

(5) The great importance nowadays of alternating current (A.C.) motors is reflected in the increasing literature of the subject. M. Lagron's book (which unfortunately has no preface) deals with the theory, design, and applications of A.C. motors, but synchronous motors are only alluded to, as they are the subject of another volume of the Blanchard series. The greater part of the book is devoted to induction motors. In this connexion there are interesting chapters on losses and heat conduction. Afterwards, chapters are included dealing with the circle diagram, starting and speed control, monophase induction motors, and testing. A chapter on design is followed by another of 30 pages, in which the detailed design of a 45-h.p. 3-phase motor is gone into. Other chapters follow on construction and application of induction motors.

Commutator motors are dealt with in a single chapter, and the concluding chapter deals with compensation in A.C. installations, and speed control of induction motors in cascade. There are four plates. The book contains a large amount of information, and can be highly recommended.

S. LEES.

Our Bookshelf.

Love's Creation: a Novel. By Marie Carmichael. Pp. iv+416. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 7*s*. 6*d*. net.

A DESIRE to have things 'both ways' is common enough, but still it is one which deserves censure rather than praise; and so it is that we approach this book with an unfavourable impression. We are told on the cover that it is by Marie Carmichael, and then a publisher's note informs us that the author is really Dr. Marie Stopes, while for shop-window display a publisher's label repeats the information. Dr. Stopes wishes to gain fame in a field other than those in which she has already made a reputation, but as she does not wish her readers to be misled by that reputation she chooses a pen-name which turns out to be no pen-name at all. The obvious question is, Why bother? And doubtless an answer just as obvious will suggest itself.

As to the contents of the book, it is a novel with a scientific atmosphere, partly obtained by much of the setting being in the University of London, and partly as it is the medium for the expression of certain scientific views. A young biologist, hitherto wrapped in his work, falls in love with and marries one of his students, whose sister marries a wealthy man who had been an old friend of her family before it was overtaken by poverty. The first of these marriages ends in swift tragedy, and the second proves not quite satisfactory owing to the lack of passion on the wife's part, but it too is dissolved by tragedy, and the hero eventually marries his dead wife's sister, who possesses the somewhat unusual name of Rose Amber, which is always given her in this double fashion. This name in some measure typifies the style of the book, as indeed also does the cover, which struck us at once as florid, and despite everything the impression remained.

The scientific portion is crystallised in a chapter which is headed by the warning that it does not carry on the story, and should only be read by those who *think* (*sic*). It consists in a popular exposition of the conception of the species as a greater unit of life, and is of course not new, and the manner in which it is put forward seems scarcely to merit the warning at the head of the chapter. We feel Dr. Stopes must do better than this if her literary name is to equal that she has won elsewhere.

W. P. K.

Introduction to Physiological Chemistry. By Prof. Meyer Bodansky. Pp. vii+440. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

ALTHOUGH entitled an "Introduction to Physiological Chemistry," Prof. Bodansky's book contains considerably more material than might have been expected in an introduction to the subject. In fact, the work is suitable for the advanced student of biochemistry, not perhaps for the specialist, but for one who is reading biochemistry in addition to some other scientific subject. The work deals with the theoretical aspect of physiological

chemistry only: it contains numerous references to original papers and structural formulæ are freely used. Numerous tables are also included which are useful, but seem somewhat out of place in a book which is not meant for a work of reference.

The general plan of the book follows the usual lines: after a chapter on physical chemistry, the carbohydrates, proteins, and fats are each separately considered; chapters on digestion and absorption and the blood and lymph follow. Metabolism is dealt with in detail, and sections on the chemistry of the internal secretions and on nutrition follow: these accounts appear up-to-date, except in one or two instances, where a marked advance has taken place during the past year. We feel that the book will be of use to those who are revising the subject for an advanced examination and to those who wish to obtain some idea of modern trends in this branch of science.

Technical Drawing: a Manual for Evening Classes and Junior Technical Schools. By G. E. Draycott. Pp. vii + 232. (London: Oxford University Press, 1927.) 6*s*. net.

THIS is a very elementary text-book intended for the use of schoolboys just beginning the study of technical drawing. Well-informed students will be familiar with some of the earlier problems, but there are always a few who seem to evade any acquaintance with this subject during their school days, and it is probably for these that the simpler problems have been introduced.

In the later chapters the book deals with some of the properties of the circle and the ellipse, the areas of irregular figures, the projection and intersection of simple solids, the development of surfaces, pictorial projections, and simple machine drawing. The examples have been chosen to suit both engineering and building students, and are presented in such a way that the use of models (which are usually too expensive to be obtained in adequate quantities) is not of pressing importance. With the addition of two or three more complicated machine drawings, this book would cover a very satisfactory two years' course of the evening continuation school type.

It is unfortunate that Fig. 157, which illustrates a rather important principle of projection, should be so obscure. On the whole, however, Mr. Draycott has produced a useful small book plainly written and clearly illustrated.

A System of Qualitative Analysis for the Rare Elements. By Prof. Arthur A. Noyes and Prof. William C. Bray. Pp. xii + 536. (New York: The Macmillan Co., 1927.) 21*s*. net.

IN recent years the line of separation of the common from the rare elements has become very indistinct, and many substances which were until recently mere curiosities in some chemical laboratories have now found extensive industrial application. Many alloys, for example, which are in common use may now contain elements such as vanadium, tungsten, molybdenum, and cerium, whilst many other uses of the rarer elements are being discovered daily. The methods of testing for these elements have not been worked through systematically as has been the case with those in use for the common elements, and the present work is therefore of great interest and value. Many of the tests and separations are quite new, and one striking novelty is the extended use of perchloric acid in many of the separations.

The second half of the book contains much detailed information on the experiments made by the authors and their students on the subject, and there are useful references to original papers, although these have been carefully selected and are not large in number. This book cannot fail to be of service both to students and investigators and also to analysts.

River Engineering: Principles and Practice. By F. Johnstone-Taylor. (Lockwood's Manuals.) Pp. xiv + 119. (London: Crosby Lockwood and Son, 1927.) 4*s*. 6*d*. net.

THE control of the flow in natural streams has been practised for many centuries, and to-day, in nearly all parts of the civilised world, one of the most important of engineering problems is the control of the flow not only for power purposes, for irrigation, and for navigation, but also to prevent silting, the scouring of banks, and to prevent valuable land being spoiled by flooding. The small volume before us attempts to give only the rudiments of the subject, and it can scarcely be said that it does even that to the satisfaction of all those who may desire information upon certain branches of river engineering. The chapters on "Hydraulic Considerations" are, probably perforce, very incomplete, and will not in themselves be very helpful to the serious student. What may be called the constructional chapters, dealing with embankments, weirs, and control, and navigation are sketchy, and scarcely give sufficient information to help in the design of particular works, but they will be found of interest as an introduction to the subject, and practical hints of importance are given in the text.

Les larves et nymphes des Dytiscides, Hygrobiides et Haliplides. Par Dr. Henri Bertrand. (Encyclopédie entomologique, 10.) Pp. vi + 366 + 33 planches. (Paris: Paul Lechevalier, 1928.) 100 francs.

THIS very complete work deals with the immature stages and biology of the Dytiscidæ and related families of water beetles found in France. Out of a total of 94 species the larvæ of which are more or less known, 44 are studied afresh and in greater detail, and 33 others are described for the first time. The descriptions are very adequate and detailed, and are accompanied by 750 figures illustrating special structural features. Entomologists will find in this work a storehouse of information respecting the families concerned: useful tables are provided for the identification of the larvæ, while the discussions on the biology, adaptations, and phylogeny of the several groups should appeal to the special student of such subjects.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Colour of the Peacock's 'Eye.'

IN NATURE of May 26 I gave an account of the effect of ultra-violet radiation on the colours of the peacock's 'eye.' During the last month of sunny weather I have had a specimen in part exposed under quartz to full sunshine—in part screened. There is a definite effect, though much less marked than can be obtained by a few hours' exposure close to the quartz mercury lamp.

The effect is best seen using a glass mercury lamp as illuminant, with an angle of incidence of about 20° from the normal.

We then see that the dark colour of the 1st zone (centre) is completely discharged, while the 2nd zone shows blue on the exposed and green on the unexposed part.

Detailed examination of the colour changes under ultra-violet light and under sunshine has not yet been made.

Mr. F. Finn (NATURE, July 14) sees reason to think that the older museum specimens of peacocks show a perceptible colour change due to light. This is in accordance with the present observations.

RAYLEIGH.

Terling Place,
Chelmsford, Essex,
July 23.

The Constitution of Germanium.

MASS-SPECTRA of germanium were first photographed five years ago by the method of accelerated anode rays. The effects then obtained were feeble, but sufficient to enable identification of its three principal isotopes, 70, 72, 74. Recently, thanks to the kindness of Prof. Dennis, of Cornell, I have been provided with some volatile compounds of this element suitable for use in the ordinary discharge tube, which so far is the only source giving beams of sufficient intensity for use with my new instrument.

Germanium tetraethyl was the first compound tried, and after one failure a better setting of the discharge tube was obtained, and the three expected lines appeared very clearly together with no less than five fainter new ones. This is the first success with a volatile metallic ethyl compound. This result was repeated, and afterwards similar results were obtained with the gaseous fluoride GeF_4. The spectra indicate that germanium has eight isotopes, 70 (c), 71 (g), 72 (b), 73 (d), 74 (a), 75 (e), 76 (f), 77 (h). The letter in brackets indicates the order of intensity. It seems very unlikely that any of these lines are due to hydrogen compounds, but the possibility cannot be entirely ruled out. Also the order of intensity is in doubt in the case of Ge^{76}, owing to the possibility of this being enhanced by the line of a compound (probably CS_2) often appearing faintly in the normal discharge. It will be noted that of all these mass numbers two only, 72, 73, are peculiar to germanium; the others all form isobaric pairs with the neighbouring elements zinc, gallium, arsenic, and selenium.

I should like to take this opportunity to point out an unfortunate printer's error in the table of atoms and packing fractions published in my Bakerian Lecture, and repeated in NATURE of Dec. 31, 1927. Mass number 81 belongs to bromine, not to krypton. Kr^{81} is a misprint for Br^{81}.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, July 21.

The Auroral Display of July 7.

A VERY unusual auroral display was observed from our north woods camp on Big Sauble Point on the eastern shore of Lake Michigan at 9.45 P.M. Central Standard Time, July 7.

At this time Vega has not quite reached the zenith and showed but faintly, so intense was the aurora. It radiated from a point about 8° south-west of Vega, which persisted for many minutes as an intense circular or oblong patch, presumably a streamer seen end-on. Radiating from this nearly to the horizon in all directions were other streamers, especially brilliant to the north-east. The dominant colour in the initial ten minutes was that of 5577·35 A., ascribed to oxygen in recent years. Later, the pink colour due to the nitrogen band systems was vivid enough in spots to suggest distant fires in the forest.

The brilliance of the display may be judged from the fact that it was possible to observe the motion of the second hand of a wrist watch and note the 5 s. division marks on the dial, and, as remarked above, only stars of mag. 0-mag. 1 were to be seen through it.

The entire absence of the characteristic arch (perhaps because it was directly overhead), combined with the aspect of streamers from directly below, is very rare at such southerly latitudes, 43° N., approximately. On the only other occasion on which we have witnessed a display similar to this, the general meteorological conditions were so unusual and so identical that we must needs mention them, although one would not expect any connexion between surface meteorology and the aurora, except the clearness that makes for visibility.

Both the displays mentioned have been associated *with fog* and high and steady wind. Over-water visibility here on the afternoon of July 7 was less than a mile and a half, and the evening was distinctly thick. The barometer was 29·1 in. and the temperature at the time of the observations 78° F., which is almost record temperature for this location. Indeed, were it not for the brilliance of the aurora on these occasions, one would attribute the low visibility of the brightest stars to fog and cloud.

The normal auroral displays are quite common here in clear cool autumn weather, but the association of two midsummer low latitude appearances with high temperature, humidity, and fog is so striking that we should appreciate any comment others may have about this, either through your columns or in correspondence.

HARVEY B. LEMON.

Ryerson Physical Laboratory,
University of Chicago.

Czechoslovakian Cytology.

MY "Structure and Development of the 'Living Matter,'" reviewed in NATURE of April 21, p. 610, discusses also the origin and fate of some components of animal and vegetable cells. Important new observations at variance with former interpretations based on Meves's work on the spermatogenesis of the guinea-pig, make a revision of the chapters on spermatid organisation indispensable. But Prof. Gatenby's paper on the Golgi apparatus and acrosome development require in their turn a revision, and this was given in "Living Matter." As its reviewer, Prof. Gatenby objects to several points referring to

the problem of the Golgi apparatus, and especially to the origin of the 'acrosome.' He tries to find fault with me for technical, personal, and formal reasons, but that is not the point here.

With regard to Prof. Gatenby's objections to the described origin and fate of the mitotic apparatus and to the origin of the acrosome in guinea-pig, he himself did not make any progress, but slipped into new mistakes, not understanding the true signification of the components in spermatids as described in my book and summarised in the following. The spermatids form after the second maturation division. The mitotic bodies of the prespermatids, not in the shape of 'idiozomes,' but as pedunculated bodies, transform into Golgi bodies and are soon ejected from the nuclear wall into the cytoplasm, where they disappear.

Another important process takes place in the nucleus of spermatids. By special processes the chromosomes transform into basi-chromatic particles and cast away the useless products, in shape of oxychromatic granules within the abundant nuclear enchylem and a certain number of nucleoli. The increased juice projects as a vacuole and is followed by the first two nucleoli, the substance of which dissolves and stiffens the vacuolic liquid. So the body called an 'acrosome' is formed. These nuclear processes produce a complete transformation of chromatin constitution. From the chromosomes of the earlier maturation generations all oxychromatic parts are ejected; there remains but a pure basi-chromatic substance in the shape of the smallest bodies, 'chromiols,' continuing into the mature sperms with solid protecting head cap on the front pole. Prof. Gatenby neglects this important biological fact and imputes to me the statement that "the acrosome is formed as a sort of coagulum from 'Karyochyme or nuclear liquid.'"

I fear that such untenable opinions will be repeated in future, if the pitfalls are not pointed out, to which such interpretations of the origin and signification of spermatids in *Cavia* are due. Many cytologists base their works on Meves's publication, without verifying its statements of spermatid origin. I undertook this ungrateful task, and the results will be published as an appendix to my book, with many drawings of mitotic bodies transforming into Golgi bodies. Prof. Gatenby would help to smooth the way for the solution of these important questions, if he would undertake the indispensable revision not only of Meves's, but also of his own accounts on the origin of spermatid structures and of their transition into mature sperms.

F. VEJDOVSKÝ.

Prague, Czechoslovakia.

PROF. VEJDOVSKÝ writes in his criticism of my review, "The mitotic bodies of the prespermatids, not in the shape of 'idiosomes,' but as pedunculated bodies, transform into Golgi bodies and are soon ejected from the nuclear wall into the cytoplasm, where they disappear." *There is no transformation of any substance into Golgi bodies.* The latter are there in the fœtal gonad, and can be, and have been, traced right through spermatogenesis until they are sloughed off. Prof. Vejdovský is recommended to try the Kolatchev or Da Fano methods, or the neutral red method on fresh cells.

Since my review was printed in NATURE, Dr. Voinov has sent me a paper, "Le vacuome et l'appareil de Golgi dans les cellules genitales mâles de *Notonecta glauca* L." (*Arch. Zool. Expér.*, 1927), in which he shows that the acrosome bead is formed away from the nucleus and is only deposited on the latter in the late spermatid. The same thing was shown by me many years before in the spermatogenesis of *Paludina*. In Lepidoptera, each acroblast (Golgi element) secretes its own bead on the nuclear membrane. The nucleus is not directly concerned.

More recently Dr. Jan Hirschler has sent me two important papers which show that the acrosome bead may be stained bright red in neutral red *intra vitam, and can be followed during its formation away from the unstained nucleus.* The latter does not stain until the cell is moribund or dead. Hirschler has worked on a number of mammals, and his figures support Meves's interpretations (see especially his most recent paper in the *Zeit. f. Zellf. u. mikr. Anat.*, p. 205, Abb. 1, p. 205, Abb. 2, for *Cavia corbaya*).

Nothing published before Prof. Vejdovský's "Living Matter," or since, supports his views. I ask him to study Hirschler's work, which is the most recent published, and has been carried out on fresh cells stained in Janus green and neutral red. This work, and that of Monné, also demonstrates that Parat's neutral red staining vacuome is not the same structure as stains black in Da Fano, Cajal, or Golgi's methods.

With reference to the main part of Dr. Vejdovský's letter, his nomenclature, like that in some parts of "Living Matter," makes it difficult to understand exactly what he means. It is certain that he wishes to declare that the acrosome is in some way of intra-nuclear origin. If there are subsidiary parts of this theme which I have misunderstood, I am sorry. I trust that in his promised appendix he will pay some attention to the work of Hirschler, Monné, Bowen, Nath, Hyman, Voinov, and to my own studies on *Paludina*, *Saccocirrus*, and *Peripatus*.

Finally, while there is little in Prof. Vejdovský's account of mammalian spermatogenesis and acrosome formation with which I can agree, his work has provided a stimulus, and will undoubtedly form the basis of much further work on the problems with which he has so long been prominently associated.

J. BRONTË GATENBY.

Trinity College,
Dublin, July 12.

The Movement of Sap in Plants.

AFTER the conclusion of his recent lecture at the University of Vienna, Sir J. C. Bose was kind enough to lend me his instruments for the repetition of some of his more important experiments in the Institute of Plant Physiology of the University. As this is the first time that his experiments have been successfully repeated in a European laboratory, the following results which I obtained will be of interest to readers of NATURE.

(1) *The Infinitesimal Contraction Recorder.*—This ingenious apparatus records the cellular contraction in the interior of the plant under external stimulation. The principle of the instrument is extremely simple; the extreme delicacy of the apparatus bears testimony to the extraordinary skill of the Indian mechanicians trained at the Bose Institute. The stem or other organ of a plant is placed between a fixed and a movable primary lever. The diametric contraction of the plant under stimulation is indicated by the movement of this primary lever, which is further magnified by optical means, the total magnification produced being a million times. The indication of the instrument is not affected by mechanical disturbances.

(2) *Sensitiveness of Ordinary Plants.*—An extremely feeble electric shock was sent through me and the plant, both being placed in the same electric circuit. The plant responded visibly by a contraction to a

shock which was below the threshold of my perception. With a stronger shock the cellular contraction was more intense; under excessively strong shocks the contractile spasm became very violent; after a short time the tissue ceased to respond, being effectively killed by the electric discharge. It is quite easy to show that the cortical cells in every section of the stem and of the leaf-joint are fully sensitive, proving a continuity of contractile cortex throughout the length of the plant. A wave of peristaltic contraction may thus sweep onward from the point of stimulation.

(3) *The Movement of Sap.*—The following striking experiment affords conclusive proof that the movement of sap is essentially not a physical but a physiological process. A cut piece of stem of *Antirrhinum* with a pair of opposite leaves is suitably fixed at the cut end in a piece of sponge. Under excessive drought the leaves fall down, become crumpled up and are wilted. A few drops of cardiac stimulant—dilute solution of camphor—applied on the sponge bring about a striking transformation. The drooped leaves are quickly revived; they rear themselves up with great rapidity, and become fully erect in the course of 2-3 min.

(4) *Active Cellular Pulsation in Propulsion of Sap.*—The pumping of sap by the propulsive tissue is clearly demonstrated by the optical sphygmograph. The flow of sap along the stem is observed to consist of a series of pulsations. The pulsatory activity is greatly increased by drugs which enhance cardiac activity in the animal; it is enfeebled or arrested by depressing agents. Extracts from certain Indian plants have a potent influence on the propulsive activity of the plant and the cardiac activity of the animal. This aspect of the investigation has roused considerable interest in the Medical Faculty of Vienna.

(5) *Movement of Sap in Sealed Stems.*—It has been thought that the movement of sap is essentially due to push from below by root-pressure and suction from above by transpiring leaves. The fact that there is an inherent activity in the stem itself, independent of those in the terminal organs, is clearly demonstrated by experiments on an isolated stem covered with impermeable varnish. The sap can now be made to flow either upwards or downwards, according to differential stimulation. The law of directive movement of sap is that it moves from the stimulated to the unstimulated or depressed region. The cellular mechanism is highly sensitive, being automatically adjusted for subserving the well-being of the plant. A local depression or stimulation makes the sap rush towards the depressed or away from the over-stimulated region. It is in this way that chemical substances stored in one region are conveyed to distant parts. By this hydraulic mechanism the plant as a whole becomes an organised unity.

I have seen Sir J. C. Bose carry out the experiments described above, and can confirm, since I have repeated some of them with Sir J. C. Bose's apparatus, that the results are as he has described.

H. MOLISCH.

Pflanzenphysiolog. Institut,
Wien, I., Universität, June 20.

Polarisation of Scattered Light-quanta.

IT is well known from the work of Barkla, Compton, and others that X-rays scattered through 90° by matter are completely polarised, irrespective of whether the electron remains bound or suffers ejection from the atom as the result of the impact of the quantum upon it. The recent discovery of a new type of light scattering with altered frequency (NATURE, May 5, p. 711) makes it of importance to ascertain whether a light-quantum which is scattered with diminished energy is less perfectly polarised than in the ordinary case.

We have investigated this question with several liquids by analysing the scattered light with a spectrograph having a suitably orientated Nicol placed in front of its slit. The results obtained are extraordinarily interesting, as will be seen from Fig. 1. Fig. 1 (*b*) represents the spectrum of the incident light from the mercury arc. Fig. 1 (*a*) represents the spectrum of the scattered light from liquid benzene, the upper and lower halves of the spectrogram corresponding respectively to the two principal directions of vibration. It is seen that some of the new lines which appear only in the scattered spectrum are actually polarised much more completely than the lines present in the incident spectrum. Further, the degree of polarisation varies greatly from line to line, some of the new lines being strongly polarised, others only very partially so. So large are the differences in polarisation that the relative intensity of the lines is quite different in the upper and lower halves of the spectrogram. In the case of amyl alcohol as well

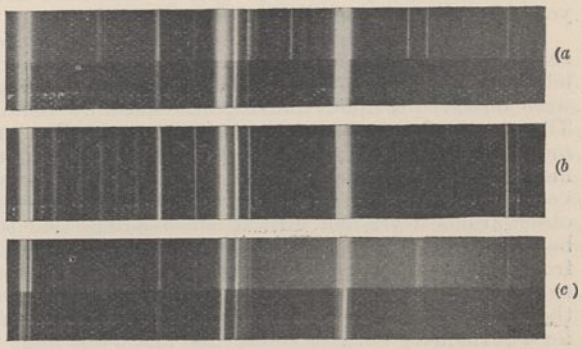

FIG. 1.

(Fig. 1 (*c*)) the new lines in the scattered spectrum are polarised to varying extents, and the continuous radiation appearing in it is also partially polarised.

The strong polarisation of the modified light scattering is intelligible in view of the analogy with the Compton effect. Since the different modified lines represent different electronic transitions induced in the molecule by the incident radiation, the varying extents of their polarisation may be interpreted as due to the optical anisotropy of the molecule being very different for different types of deformation. That some of the intense modified lines are polarised even more strongly than the unmodified lines need not occasion surprise, if we remember that the classical light scattering in a liquid is much less perfectly polarised than the scattering by the molecules of the corresponding vapour. If we assume that the modified scattering is an incoherent type of radiation, we should expect its intensity to be proportional to the density of the fluid, and its polarisation to be comparable with that of the classical scattering in the corresponding *vapour* (not liquid). These expectations appear to be not very far from the truth.

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

210 Bowbazar Street,
Calcutta, June 14.

Molecular Measurements by Optical Lever.

FOLLOWING preliminary experiments performed more than two years ago, I have now arranged an optical lever of precision, giving very large magnification, and applied it to test (*a*) the accuracy with which a steel-to-steel contact will return after separation, and (*b*) whether the thickness of a mica sheet can be

detected as varying in multiples of the molecular 'length.'

The lever has an effective length of 0·0337 cm., and consists of a vertical piece of thin steel sheet (about 1 cm. × 1 cm.) to the lower edge of which three $\frac{1}{32}$ inch diameter ball-bearings were soldered, not quite in a line. The outer ball-bearings rest on the two poles of a permanent horse-shoe magnet, enabling the lever to be conveniently maintained in equilibrium (even though the central ball is only $\frac{1}{3}$ mm. out of line with the outer ones). The beam of light, after reflection from the mirror, forms an image (of an illuminated slit) at about 123 cm. from the mirror. This image is viewed through a Hilger travelling microscope graduated to $\frac{1}{100}$ mm. (read to $\frac{1}{1000}$ mm. by estimation). A setting can be made considerably more accurately than to the half-width of the central bright diffraction band. (See Dr. Burton, *Phil. Mag.*, 1912.) The average of ten consecutive microscope settings had a probable error of about $\frac{1}{1000}$ mm.

The results of the tests on a steel-to-steel contact show that contact can be repeated (when care is taken) to approximately $\frac{1}{3} \times 10^{-7}$ cm. (These tests have not yet been fully analysed.)

A thin sheet of mica was then placed under the central leg of the lever. On tilting the lever and letting it return on to the mica, changes in reading were observed without moving the mica by hand. Three sets of experiments were performed. Ten or more microscope settings were made between one move of the lever and the next, and successive mean values were subtracted. (In two of the three sets of observations a gradual drift of the readings had to be allowed for.) The 32 differences so obtained ranged from 0·0005 mm. to 0·45 mm. (The differences appear to have a probable error of the order $\frac{1}{1000}$ mm.) Of these, the 20 readings below 0·040 mm. were analysed for a periodicity between 0·004 mm. and 0·020 mm.

A periodicity of about 0·00745 mm. was found, its presence not being accountable for by 'chance.' This corresponds to an integral change in the thickness of the mica of about

$$\frac{0{\cdot}000745 \times 0{\cdot}0337}{2 \times 123} = 10{\cdot}2 \times 10^{-8} \text{ cm.}$$

(The mica used was white and biaxal, but has not been definitely identified.)

This value may be compared with that obtained by C. Mauguin by an X-ray method (*Comptes rendus*, p. 288, July 25, 1927) of $9{\cdot}95 \times 10^{-8}$ cm. for muscovite or white mica ($Al_3Si_3KH_2O_{12}$).

The 12 larger readings not included in the above analysis do not contradict the above estimate, but do not give any measurable evidence for the periodicity. It is not difficult to see reasons why this may be the case.

It is hoped that a fuller account of these experiments may be prepared for publication shortly.

W. N. BOND.

Physics Department,
University of Reading,
June 26.

Quality of Soil in Relation to Food and Timber Supply.

I HAVE read with great interest the lucid letter by Mr. Forbes under the above heading which appeared in NATURE of July 14, p. 54. When replying to Mr. Hiley's letter in NATURE of June 2, I did not rule out the importance of the production of meat as one source of the food supplies in Great Britain, as the last sentence of my reply bears witness. I am in agreement with Mr. Forbes when he says that many of the forests producing commercial timber in Europe are growing on soils which are by no means poor. But in many cases these soils would become poor and degraded if the forests were cut down and the land left exposed for a long period. Instances are known to me in Europe where magnificent hardwood forests are occupying a light soil of low quality, as is evidenced by the agricultural land in their vicinity. The latter areas once formed part of these forests and produced as fine a timber. It would now take a rotation at least before they could be brought into a condition to produce the same quality timber. It is known that areas which were disforested as late as the early years of last century now consist of a very poor agricultural soil.

Those possessing a first-hand knowledge of the disforestation which has proceeded apace in parts of the British Empire overseas are well aware of numberless cases where the hopes based on the agricultural development, to promote which the areas were disforested, resulted in disappointment. The land, with the long built-up humus layer and resulting forest soil, was a good forest land; but once exposed soon became worthless for agriculture.

Mr. Forbes says, "a country cannot both have its cake and eat it." We ate our 'cake' when our ancestors, several centuries ago, cut the forests, both from the real agricultural lands and from the true forest ones. The latter have since been woefully mismanaged, and Mr. Forbes rightly fears that they will not produce commercial timber. The same applies to many of the poorer degraded grazing grounds. But this is no argument justifying the forester selecting agricultural land, however poor from the agricultural point of view at the present day, and placing it under tree crops. I repeat that the money, in a densely populated country like Britain, would be more correctly spent in improving the food-producing lands, whether crop or meat ones. In parts of Europe the improvement of the grazing lands is a recognised part of the forest officer's duties; it has been brought to a high level and merits a close study by foresters in Great Britain.

As regards the production of timber, it may be suggested that the State forester's real business in Britain is to set to work to bring back the poor degraded forest soils to a state in which, in a future rotation they will be able to produce commercial timber—a heart-breaking and thankless task for the present and several future generations of foresters, be it admitted. But if we are considering the economic position from its broadest viewpoint, in the interests of the nation in the future, a century or two hence, this, from the professional point of view, is the present chief duty of the State forester—and a hard one.

THE WRITER OF THE ARTICLE.

Overpotentials produced by Films of Hydrogen less than one Molecule thick.

IN the course of recent work in the Physical Laboratory of this University on hydrogen overpotential at a mercury cathode, large changes of electrode potential were found to take place, and considerable overpotential was produced with depositions of hydrogen corresponding to very much less than a monomolecular layer. It was felt that these observations were of considerable interest, as they showed that, for the overpotential so obtained, any theory requiring gas in bulk (such as a surface tension theory, or one requiring a continuous film offering resistance to the current) would be untenable.

We have since had the opportunity of reading some unpublished work by Mr. F. P. Bowden carried out in the Physical Chemistry Laboratory in Cambridge with Dr. E. K. Rideal. He arrives at the same con-

clusions, using a rather different method. Although Bowden's work is very much more comprehensive and complete than our own, we feel that a brief account of our results obtained under different conditions may be thought of interest as confirming his. The results are also interesting as indicating the nature of residual current.

In our work a pool of carefully purified mercury of about 7 sq. cm. area was used as cathode, the electrolyte being normal sulphuric acid. Air was dispelled from the cell by boiling and cooling under a stream of hydrogen, obtained by electrolysis from a portion of the same solution. A very thorough elimination of oxygen was absolutely essential. A current of the order of 10^{-4} amp. per sq. cm. of cathode surface was then passed to the mercury as cathode for a few minutes to deposit any stray mercury ions that might be in the solution. After standing for a minute or two the electrode was positive to the saturated calomel electrode, that is, its potential was more positive than the hydrogen electrode by more than 0·3 volt. On passing a current of the order of 1 micro-amp. per sq. cm. to the mercury as cathode, the rise of potential could be followed easily with a potentiometer. Overpotentials of 0·3 or 0·4 volt were produced (that is, the electrode potential changed by 0·6 or 0·7 volt) when less than one-eighth of a monomolecular layer had been deposited. From the nature of the time rise curves there were indications of oxygen being incompletely eliminated, and it seems probable from this and other observations that a still smaller deposition would give rise to an overpotential under ideal experimental conditions.

Unless the greatest care was taken to remove oxygen, no overpotential was produced with currents so small as this; instead, the familiar effect of residual current was observed at a potential more positive than that of the hydrogen electrode. This was evidently due to depolarisation by dissolved air.

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Correlation.

IN NATURE, June 2, under the heading "Correlation," Mr. Dufton refers to a graphic method for the determination of a linear function, from 14 points, which must be taken as having the same weight, in the absence of any information as to their respective worth.

It is difficult to follow Mr. Dufton's method. He refers to the 'median of X,' without defining what is meant by this. The figure shows a vertical dotted line, likewise unexplained, except that there are seven plotted points on each side. The line seems then to have been drawn at random, except that the same number of points is found on either side. But any person accustomed to graph work can see at once that the line is wrongly placed: the points on one side are as a whole farther from it than the points on the other side; in other words, the line does not pass at all *evenly* among the points.

Readers of NATURE may be interested to know that while there is no need to have recourse to the method of least squares in such a simple case, yet there is a method which enables one to ascertain fairly accurately the position of the graph. It is Cauchy's method, which yields in a few minutes, in this case, the equation $y = 9{\cdot}25 - 0{\cdot}75x$. This line passes through two of the given points ($y = 7, x = 3$, and $y = 1, x = 11$), and it satisfies also Mr. Dufton's criterion, as it has six points on each side, but a glance shows that it is a far better solution, as it is possible to 'pair off' the points so that the points of each pair are very nearly symmetrically distributed with respect to the graph, which is not possible with the graph given by Mr. Dufton. The points below the line are, except one, much nearer than the points situated above the line, as can be verified by drawing the line representing the above equation.

Cauchy's method appears to be practically unknown among physicists and engineers. It applies to functions of a higher degree as well. A description of this method for the determination of the constants of empirical formula will be found in *The Engineer* for Sept. 13, 1912, p. 267, with applications to functions of the first, second, and third degree, completely worked out.

It is easy to go astray when drawing a line to suit points so erratically distributed as those in the example selected by Mr. Dufton, and a method which enables one to obtain the equation without fumbling is invaluable in such cases.

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The Arc and Spark Spectra of the Halogens.

THE issue of NATURE for June 30, 1928, contains a very interesting note from Dr. Laporte on the arc spectrum of chlorine. The reader will, however, be surprised to find it stated there that the separation of the chlorine lines into arc and spark lines has not hitherto been accomplished, reference being made to Kayser's "Handbuch," which lists the two types of lines together indiscriminately.

So long ago as 1915, Nelthorpe showed (*Astrophysical Journal*, vol. 41, p. 16) that the two sets of lines are quite well distinguishable by their different behaviour in a condensed discharge. More recently L. and E. Bloch (*Annales de Physique*, vol. 7, p. 206, and vol. 8, p. 397) have given a complete separation of the arc and spark spectra, as well as a division of the latter into spectra of the first and second orders. This division has been effected not only for chlorine, but also for bromine and iodine (*Comptes rendus*, vol. 180, p. 1740; 1925; and vol. 184, p. 193; 1927). We may add that in the meantime a third order spark spectrum of the latter metalloid has been found, well developed in the ultra-violet. The data have been examined, and have already led us to a recognition of some fundamental terms in the spectrum Br II.

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The Green Flash.

IN some localities the green flash at sunset is by no means so rare a phenomenon as might be inferred from Prof. Wood's experience on the Atlantic Ocean and from the letters of some other correspondents of NATURE. Here in Southern California in the last two years, I have seen the flash many times as the sun has set over the Pacific Ocean, or over the Santa Monica Mountains a few miles west of our residence. On one occasion Mrs. Barnett and I both saw the flash as the sun sank behind a dense cloud; and at least once I have seen the colour of the flash change distinctly from green to blue or blue-green before disappearance.

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May 30.

Cancer Problems.

THE International Conference on Cancer arranged by the British Empire Cancer Campaign was held in London on July 16–20. The mornings were devoted to sectional meetings and discussions at the house of the Royal Society of Medicine and at the College of Nursing next door; in the afternoons visits were paid to various hospitals and other institutions, where more practical demonstrations were given. More than a hundred delegates came from the British Empire, most European countries, the United States, China, and Japan, and more than two hundred from British institutions. The whole occasion went off very well. It is impossible to give any complete account of the proceedings: we deal only with a few topics of more general interest.

More than twenty years ago, Bashford and Murray showed that a malignant tumour of epithelium (carcinoma), propagated by being transplanted from mouse to mouse, might occasionally cause the normal connective tissue in contact with it to take on the characters of a malignant tumour and become a sarcoma with the characteristic capacity for indefinite and independent growth. It seemed evident that some substance must pass out from the carcinoma cells to influence the adjacent connective tissue cells. All attempts, however, to demonstrate such a substance by inoculating extracts of carcinomata and similar experiments were uniformly unsuccessful until, in 1912, Rous and Murphy found several sarcomata of fowls in which this carcinogenic substance was so stable that it could be extracted and studied at leisure. A number of similar tumours have since been found in fowls by other observers. With most tumours transmission from animal to animal can be effected only by the transference of live cells; these Rous tumours can be transmitted by ground-up cells, dried cells, and by extracts which have been filtered through porcelain so that they contain no recognisable remains of cells at all.

The activity of these extracts, in which the active agent has a limited stability and persistence, in inducing malignant tumours in fresh fowls is conditioned by a number of factors which are not clearly defined and about which there has been a good deal of difference of opinion and experience in recent years, since Gye revived interest in the matter by his fresh interpretation. Acidity, alkalinity, mechanical and chemical injury, etc., have been found to influence the result; particular interest attaches to the action of extracts of other tissues which, it appears, may have either a favourable or an inhibitory effect.

Whether the active agent in these extracts can fairly be called a virus depends to a considerable extent on what 'virus' means. If it connotes an organism capable of independent life and multiplication of the same order as is enjoyed by most ordinary bacteria, the evidence is distinctly against the Rous tumour being a 'virus' disease, and at the Conference, Dr. J. B. Murphy, of New York, brought forward further observations which make it scarcely possible to believe in a 'virus' interpretation of the facts. He showed that by differential precipitation of Rous tumour extracts by electrodialysis (or simply by acidifying the extracts) the whole of the active agent could be separated. It appears to be mainly or wholly a nucleoproteid and can be dissolved and reprecipitated repeatedly without losing its activity: it still produces tumours in fowls with great regularity, and can also be found in the blood of fowls with developed tumours.

The isolation of this active agent is the logical sequel to Bashford and Murray's experiments. It has been possible because these particular fowl tumours contain the agent in such a form that it will tolerate experimental manipulation.

Such experiments involve the use of materials derived from an existing cancer: they may explain how a tumour involves neighbouring cells in its mad career, but they do not necessarily throw any light on how a tumour originates *de novo*. All the available evidence is against the idea that the active agent spreads from one individual to another, and it is in connexion with the popular idea that cancer may be 'catching' that the use of the word 'virus' is practically undesirable. The outstanding piece of progress in respect of our knowledge of the origin of fresh cancers, which was dealt with in a variety of ways at the Conference, is the cumulative realisation of the importance of chronic irritation and injury and the progressive implication of the products of burnt coal as the most effective irritants known.

Clinically and epidemiologically, instances of the relation have multiplied steadily during the last fifty years: the kangri cancers of the belly wall in Kashmir, the cancers arising in X-ray burns, and the appearance of mule-spinners' cancer in Lancashire, are practically human experiments on a big scale. The recent increase in cancer of the lung was the subject of a special discussion at the Congress, and everyone looked for the explanation in some new sort of irritant—the influenza of 1918–19, tarred roads, motor fumes and oil, cigarette smoking, and what not. It is becoming easier to understand why the great majority of human cancers occur in a limited number of places in the body—uterus, breast, lips and mouth, stomach, large intestine and rectum.

While, therefore, the importance of irritation was fully recognised, the influence of the qualities of the irritated tissues (*i.e.* of the constitutional factor) was illustrated by Miss Maude Slye's account of her mice in Chicago. By selective inbreeding she has on one hand so intensified the tendency to develop cancer in a given environment, and on the other hand so eliminated it, that she has two groups of animals in which almost all, and scarcely any respectively, develop tumours. By a unique piece of devoted work she has shown that the incidence of fresh cancers is partly dependent on heritable

qualities. Mating which is selective *qua* cancer is at present not practised by man, and in human experience heredity is negligible. But with the same inducement in the way of irritation, some people are no doubt more liable to develop tumours than others.

No one succeeded clearly in reproducing this experience about irritation experimentally until, in 1914, Yamagiwa and Ichikawa showed that cancers of the skin could be produced fairly regularly by the patient and persistent application of tar to mice. In other animals it is more difficult, and we owe one great advance in our knowledge of cancer to this peculiar susceptibility of mice just as we owe another to the exaggeration of the active agent by the Rous tumours. General principles are often revealed by special instances.

This great discovery is important in many ways. It put into the hands of experimenters a method of producing new cancers at will. Using it to test the carcinogenic properties of various irritants, they have found that coal products have an efficacy which seems to be unique: tar and soot and mineral oils and various preparations made from them all contain something (which has not yet been precisely identified) which causes cancer more or less readily in mice. We have here the experimental verification of the association recognised long ago in chimney-sweep's cancer of the scrotum, and in such statistico-geographical inquiries as those of Mr. C. E. Green, who clearly worked out the connexion between cancer and burnt coal with a layman's enthusiasm and common sense. The case against soot has come to be a very strong one.

If cancer can be produced by irritation, it is reasonable to assume that the active agent has originated in the irritated tissues. It is known from a variety of evidence that the products of the autodigestion which dead cells undergo in the body stimulate the growth of cells, and that the tissues of embryos are particularly rich in these growth-promoting substances. The implantation of embryonic cells into the body of an animal of the same species does not give rise to a tumour. But, as Carrel showed, a positive result may occasionally be obtained if to the mashed-up embryo a little arsenic or indol is added, which also by itself would be ineffective. The next step in this sequence also came from Dr. Murphy at the Conference. He announced that by treating the testicles of normal fowls by the same technique that resulted in the separation of the active agent from fowl tumours, he had obtained a preparation which caused malignant tumours when inoculated into fowls. Dr. Leitch also stated that he had found that extracts of pancreas were singularly effective in aiding the action of tumour extracts, and that on one occasion he had succeeded in producing a tumour with an extract of normal pancreas by itself.

These remarkable results of course require confirmation, but they are not unexpected, and follow naturally from our previous knowledge. They suggest that tar, for example, unmasks an active agent which is normally present in an ineffective form or is held in check by the resistance of the tissues. It may be that the active agent arises (or is let loose in an effective form) in the body as the result of cell injury and degeneration much more often than we commonly suppose, and that it fails to give rise to an obvious cancer either because ancillary substances are absent or because inhibitory substances or processes are present. The practical problem of cancer prevention may perhaps be more fruitfully phrased as, Why does not everybody have cancer? rather than as, Why do some people have cancer?

The only other point requiring mention which came out clearly at the Congress is the substantial practical advance which has been made in treatment by radium. By dispersing the radium throughout the substance of the tumour and in its neighbourhood, and by using small doses for long times rather than large doses for short times, there is no doubt that a good many cases of cancer can be cured, and most material alleviation can be secured in cases which have progressed too far to stop. At the same time, there is no justification for any talk about surgery being eliminated. The present price of radium seems to need some justification. How it operates is still not understood. The radiations may act better than other differential killing agents because of their nature or because they impinge continually upon the tissues without being too concentrated at their point of origin: like other harmful agents, they kill the cells of tumours more easily than those of normal tissues.

The International Research Council.

THE fourth General Assembly of the International Research Council was held at Brussels on Friday, July 13. M. Picard, president of the Council, presided, and the meeting was attended by delegates from most of the countries adhering to the Council. A meeting of the executive committee had been held on the previous Wednesday. The report of the general secretary, Sir Arthur Schuster, was presented, and a number of resolutions adopted. The report showed that at the conclusion of the extraordinary general meeting in June 1926, the secretary had taken steps to inform the nations concerned of the unanimous decision to invite Germany, Austria, Hungary, and Bulgaria to join the Council and the Unions attached to it.

Austria, Hungary, and Bulgaria each possess an Academy, which is the recognised authority in scientific matters, and invitations were sent to each of these; at the same time their diplomatic representatives in London were informed. In the case of Germany there is no single representative Academy. The Foreign Office in London was consulted, and by its advice an invitation to join was

transmitted to the German Government through the British representative in Berlin. Letters were, in addition, addressed to the Academies of Berlin, Göttingen, Leipzig, and Munich. It was not realised at the time that there is now a fifth German academy at Heidelberg.

The Austrian Academy of Sciences intimated through the Austrian Legation that it considers the unanimous invitation extended to Austria and Germany as an important step in the direction of a re-establishment of normal co-operation between scientific workers of all nations. In view of the fact that the Academy of Sciences is affiliated to the Verband der Deutschen Akademien, a final reply can only be given later after consultation with the members of that body. It appears, however, that the Geodetic Commission of Austria is interesting itself in the matter, and is taking steps which may lead to the adhesion of that country. The reply from Bulgaria, through the Legation in London, thanked the Council for the invitation, but expressed regret at being unable, for purposes of economy, to share in international scientific work. From Hungary a cordial and immediate reply was received, and in due course Hungary formally adhered to the Council. From Germany no definite reply has reached the secretary, but it appears that the central government has submitted the question of acceptance to the Verband der Deutschen Akademien. It is understood that objections have been raised by this body on the grounds that the International Research Council is an Association of governments rather than of scientific bodies.

In this connexion it is pointed out in the report that of the thirty-five countries adhering to the Council, fourteen are represented by their scientific academies and six by national research councils specially constituted for the purpose, composed of representatives of the national academies; these are as independent of government control as the academies themselves. Among these are the United States of America, Italy, and Japan; while of the remaining fifteen, Latvia is represented by its Chemical Society, and seven by some scientific department connected with the government. In seven cases only is the government the controlling body.

Since in practically all cases the funds are found from government sources for the administrative work of the Council itself, some link with the government of a country is required, but for the scientific work carried out by the Unions each properly accredited delegate has one vote and there is complete freedom. It is quite open to the five German academies to form a national research council which could then adhere to the International Research Council.

The convention, under which the Council works, comes to an end, unless previously renewed, in 1931. In view of this fact the Royal Society had given notice of a resolution in the following terms:

"The Council of the Royal Society have had under consideration the fact that the Convention under which the International Research Council is constituted lapses, unless renewed previously, on 31st December 1931.

"They realise that the renewal of the Convention will carry with it changes in certain of the Statutes, and that the whole question will involve a full and careful consideration of the circumstances by the Nations adhering to the Council. They consider it important that a representative Committee should be appointed at the forthcoming Meeting of the Council next July to consider and report on the matter some considerable time before the Meeting in 1931, at which a definite decision must be taken, and further that a general discussion should take place this year in order that the Committee, if appointed, might have before it a general impression of the views of the Delegates on this subject.

"The Royal Society therefore give notice that its Delegates to the Meeting of the International Research Council will propose:

"(1) That a Committee be appointed to consider what changes, if any, should be introduced in the Statutes of the International Research Council and its Unions to take effect on the expiration of the present Convention (31st December 1931).

"(2) That for this purpose the Committee shall enter into communication with the Unions, the Bodies adhering to the Council and such other bodies and persons as it may consider advisable, and present a Report to the Executive Committee of the Council not later than 30th June 1930."

Italy had also given notice of its intention to raise the same question, while previously to the meeting the resolution of the Royal Society had been supported by the United States, Spain, Holland, and Czechoslovakia.

After discussion by the Council the resolution of the Royal Society was accepted unanimously, and at an adjourned meeting a representative committee of fourteen members was appointed, with Sir Henry Lyons, one of the Royal Society delegates, as its secretary.

A further resolution, moved on behalf of the Royal Society, dealt with a matter which has been causing some difficulty. According to the statutes of the Council, any change in the statutes of one of the Unions requires the approval of the Council before becoming effective, and this leads to delay, since the Council only holds triennial meetings. To meet this difficulty it was agreed to delegate to the executive committee, during the interval between two assemblies, the duty of approving changes proposed in the statutes of a Union, provided those changes were in accord with the statutes of the Council.

Certain questions as to the method of stating the amounts due from a country to the Council or its Unions were left to the secretary to deal with, and the necessary action was taken with regard to other minor questions which had been raised.

Two vacancies on the executive committee were filled by the re-election of Signor Volterra as a vice-president, and Sir Arthur Schuster as general secretary, and the meeting terminated with a vote of thanks to the president.

Agriculture in India.[1]

IN the previous article special attention was directed to agriculture, the first of the two main subjects dealt with by the Royal Commission on Agriculture in India; and it is perhaps worth while emphasising here that this term has a much wider significance in the tropics than in temperate regions. The employment of the people is much more uniform and less divided into watertight compartments, and that employment is in the vast majority of cases connected with the cultivation of the land. Modern industrial development is in its infancy, and even such as exists is largely concerned with the preparation and utilisation of plant products. Irrigation, with its engineering problems, is closely connected with agriculture, and especially so in such a dry country as India. Forestry, often only of late years separated off, has many lines of contact; either direct, as in the gathering of crops, provision for grazing, wood for implements, and leaves for manure; or indirect, in its effect on the soil, water for irrigation, and the amelioration of climate. Even fisheries overlap, whether in the supply of manure or occasionally in the 'rotation of crops.'

Co-operation is peculiarly important in the development of agriculture; communications are necessary for transport, marketing, and export, while medical work and sanitation have much to do with the ability of the labourer to perform his tasks in an exacting climate. Ultimately, the whole economics of village life and the education and general uplift of the rural population are of fundamental significance. To consider Indian agriculture only in the narrow western sense would be a colossal blunder, and, as we have indicated, there was no intention that the work of the Commission should be thus limited. To all of these subjects, largely embryonic in the tropics, the Commission has turned its attention; and zealously lays them under contribution for the betterment of the second main subject of reference, namely, rural economy.

One section included under agricultural research remains to be dealt with, and that is animal husbandry, so closely related to the raising of crops as to be inseparable from it. In the monsoon regions, cultivation of the soil and transport of its products depend on cattle, in contrast with the hand labour and head loads of large portions of Africa and the machinery of western countries. Cattle in India are not required for meat, so that their use as draught animals is peculiarly important. The subject is dealt with by the Commission in two long chapters (vii. and ix.) covering 130 pages, somewhat curiously separated by that on forestry, and it is discussed in great detail. As contrasted with the raising of crops, the study of cattle has more definite units and is thus simplified; the staff employed is, moreover, more numerous and has been longer at work.

The number of livestock in British India is given as 151 millions of cattle and buffaloes, and 62·5 million sheep and goats; while in such native States as have records the figures are 36 million and 25 million respectively. Compared with these figures, the numbers of horses, mules, donkeys, and camels are insignificant—another point of contrast with other parts of the world. The main function of cattle in India is draught, although buffaloes are also valuable draught animals: milk is chiefly obtained from the latter. The Commission records its opinion that, in comparison with other countries, the number of cattle is in excess of that needed for cultivation, and finds that this is due to series of factors working in a vicious circle. The cattle are in general small and weak for their work: the smaller they become, the greater numbers are reared to get useful bullocks: this increase in numbers causes larger areas to be cultivated at the expense of grazing grounds: the actual working cattle alone receive attention as regards their food, and the calves and mothers get what they can: the result is smaller and weaker calves. . . . The points of policy should be reduction in numbers and increase in efficiency, better cultivation of smaller areas, and more attention to cows and cows-in-calf. Feeding and breeding are, and always will be, the main lines for the improvement of Indian cattle; here and there throughout the country are found fine types carefully treated, which might serve as examples to be followed. The possibilities in these and other directions are exhaustively explored in the report.

The ravages of disease are dealt with in Chapter ix. Rinderpest, hæmorrhagic septicæmia, and foot-and-mouth disease are the most serious; and the methods adopted in checking the first of these, which takes the greatest toll of cattle annually, are described as typical of control work. For efficient cattle work the Commission considers that one inspector should be provided for every 25,000 cattle. There should be a superior officer in each district with an appropriate number of inspectors under him, which would mean 300 district officers and 6000 inspectors for British India. An all-India veterinary college on the lines of Pusa is not advocated. The existing research institute at Muktesar should not be saddled with training work, as this can be efficiently carried out in the provincial veterinary colleges; but the director at Muktesar should have the assistance of an officer experienced in administrative work.

Forestry is sometimes called 'the handmaiden of agriculture,' and is only considered in this capacity by the Commission. It is suggested that grass cutting should be developed wherever possible in place of grazing. Fuel is one product for which forests might reasonably be held responsible, but large cultivated areas have no forests to speak of, and everywhere cowdung is preferred; and, although the Commission suggests the study of possible substitutes, there seems little likelihood of any change from this continual destruction of cattle manure. A re-classification of forest areas is recommended, according to the uses for which

[1] Continued from p. 135.

they are designed : for timber and fuel, those desirable for physical and climatic reasons, fodder and grazing, and those more suitable for cultivation. One of the most promising lines would be the handing over of certain tracts adjoining villages for control by them under certain restrictions.

The chapter on irrigation enumerates the projects at present being developed in the different provinces. For the rest, the Irrigation Committee of 1903 is stated to have treated all aspects in such a comprehensive manner that no further inquiry was considered necessary.

Communications and marketing are appropriately considered together in Chapter xi. The opening up of the country has had the effect of introducing money crops, that is, those for sale in place of direct consumption. Evidence shows, however, that there has been a deterioration in the character of the roads during recent years ; and on this account the Government of India has instituted a Road Development Committee. But this appears to deal primarily with the arterial roads, and the Commission again urges the importance of those leading to the villages, seeing in them a ready means of stimulating village thought by bringing them into closer connexion with the towns.

Although the Agricultural Department has done much to improve the quality and increase the quantity of the cultivator's products, comparatively little seems to have been done to enable the producer to get the full advantage of this. Markets are numerous in India ; for example, in Bihar and Orissa there are 432 principal and 2624 minor ones, and much information has been brought together and collated by the Commission. It suggests, however, that a regular survey of markets should be taken in hand, and that an expert marketing officer should be attached to each provincial agricultural department. A further attempt should also be made to standardise the weights and measures throughout India.

Under finance, land mortgages are somewhat fully considered, and the importance of facilitating redemption within a reasonable period, say twenty years, is insisted on. The Commission resolves that "the greatest hope for the salvation of the rural masses from their crushing burden of debt lies in the growth and spread of a healthy and well-organised co-operative movement, and local governments should, therefore, give that movement all the encouragement possible."

Co-operation is very fully discussed in Chapter xiii., and the remarkable advance made in recent times is indicated by a table showing a quadrupling of credit societies during the past eleven years—from 16,690 to 65,101, with a like rise in the number of members and a somewhat greater increase in capital. "Where the co-operative movement is strongly established, there has been a general lowering of the rate of interest charged by money-lenders ; the hold of the moneylender has been loosened, with the result that a marked change has been brought about in the outlook of the people."

The formation of non-credit societies (such as for seed, implements, manures, cattle insurance) is naturally a later growth ; they are a much more difficult proposition, because of the need of business capacity and expert advice. The figures given in the same table for the past eleven years show an increase from 96 to 2133, with a much greater rise in the number of members and a still greater rate of increase in the amount of capital involved. The Commission records its opinion that single purpose societies are to be preferred to multiple purpose societies.

In Chapter xiv. the Commission returns to "The Village," and deals comprehensively with sanitary and medical matters, and especially with the various agencies, official and non-official, for the improvement of the amenities of village life. This is an exceedingly interesting and inspiring chapter, and the members of the Commission evidently have the matter very much at heart. They take the long view and enumerate, at length, the various possible directions in which they consider that a betterment can be brought about : they recognise that progress must be slow, and can only be effected through the will of the people themselves, and that a public opinion must be created among them.

Those who know their India may perhaps feel that the view is so long that it sometimes tends to become visionary. We read that in the latter days "the old men shall dream dreams and the young men shall see visions" ; and it is therefore appropriate that the Commission should turn for help to the universities, who "have at once an obligation and a great opportunity to assist in the work of rural development on both its economic and educative sides." Leadership is in fact required, and must come from outside. An interesting local solution is described from one of the districts in the Punjab, where young men are carefully trained as 'guides,' and each is posted to a number of villages to act as propagandist for improvements of all sorts and as counsellor in all welfare matters. These young men are not experts, but know where to look for them, and can thus act as connecting links between the villages and the various departments—agricultural, medical, co-operative, and so forth.

The Indian Research Fund Association is quoted as an admirable example of combination of private and official effort. The line of research under this foundation which comes to one's mind is that on human and animal nutrition, already referred to in these columns. A great extension of this class of work is hoped for by the Commission—a concerted effort to improve the nutrition contained in the diet of the cultivator is a pressing need.

Education, perhaps fittingly, occupies the next chapter, for "few problems have been more anxiously debated as to the type of education best adapted to an agricultural population. . . ." "The idea that education in rural areas should bear a close relationship to the daily lives of the people is but a recognition of the truth that the environment in which rural workers live is different from that in towns." There is not space to analyse the mass

of facts and ideas which are contained in this chapter, and we shall content ourselves with selecting two of the Commission's conclusions.

The first is in connexion with the influence of female education on rural development. Very few boys attending the primary schools in British India stay long enough to attain permanent literacy. In 1921–22 the proportion of boys attending primary schools was 32·2 per cent of the population, and that of girls 7·6 per cent. On the other hand, the percentages of literacy at 20 years and above were 18·13 and 1·9 respectively: it is evident that girls especially do not stay long at school. It is argued that if a mother is literate, a very strong influence will be brought to bear on keeping her children at school until literacy is assured. The Commission, for the purpose of testing this idea, suggest that "a definite effort should be made to impart literacy to a certain number of young mothers" and the results be carefully recorded.

The second is concerned with the kind of education to be given to older boys in rural India. Two existing types of such education, for boys from fourteen to seventeen years of age, are described and contrasted. In the first the school is vocational, being in fact an agricultural college and farm in miniature, with the important proviso that if the whole four-year course is gone through, all charges will be met by the school; in the second, agriculture is a voluntary subject in a vernacular middle school. The first type, started in 1910 in Bombay, has slowly extended, but it has not been taken up to any extent elsewhere: there are six schools of this type at present. The second type was started in the Punjab in 1923: there were 66 in 1926–27, and it was hoped that there would be 121 in 1927–28. In the United Provinces 20 such schools exist, where, however, agriculture is compulsory. Farms of three acres are intended, but all are not as yet provided with these. The Commission is strongly in favour of this latter class, financially and otherwise. It does not consider that the heavy cost of free vocational schools is justifiable, and there appears to be no general call from the people for them.

The remaining chapters deal with rural industries and labour, horticulture and plantations, and agricultural statistics. There are a number of graphs interspersed and a short series of appendices.

News and Views.

ETHYL petrol—the only motor spirit on the market which contains any lead compound—is, after all, adjudged to be not so deleterious when used under proper safeguards as has been feared in some well-informed quarters. The Departmental Committee which was charged with the examination of the question has issued a unanimous interim report in which it states that, having considered the experimental work which has been done in America, and the evidence which it has itself taken, and having discussed the matter with high officials of the United States Public Health Service, it has reached the conclusion that the findings of the United States Government Committee were justified, and that further experience has supported its conclusion that there are no reasons for prohibiting the use of ethyl petrol. The British Committee does not minimise the risks of using either ethyl or ordinary petrol when ordinary safeguards, such as proper ventilation in garages, are lacking, but it believes that provided ethyl petrol is used solely as a motor fuel, and not for such purposes as cooking or cleaning, its use does not involve a special risk. The dangers attending the manufacture of lead tetraethyl for incorporation into the 'ethyl fluid,' and even the operation of mixing the fluid with petrol, are, of course, in another category. The former operation is not carried out in Great Britain, but in the United States of America it proceeds under proper regulations; the latter stage in the preparation is carried out in Great Britain at nine stations, where the precautions suggested by the United States Committee are observed in all respects, and the arrangements are such that the health of the workers is fully safeguarded.

SCIENTIFIC men who were aware of the peculiarly toxic nature of the material to be employed in the manufacture of ethyl fluid, and of the cumulative effect of the poisonous action of lead compounds in general, and who therefore entertained anxiety concerning the ultimate effect not only on users of the spirit but also on any who might be compelled to breathe an atmosphere polluted with exhaust gases, would have been lacking in an adequate sense of public duty if they had not given expression to their doubts. So far as the evidence is available at present, these fears are not necessarily without foundation, but at least they appear to be concerned with a risk sufficiently circumscribed to fall within that margin of common hazard which modern man has to accept with the other blessings of his civilisation. It remains to be seen whether with the passage of time no such evidence will present itself; in the United States, however, ethyl petrol was in use for some three years before it was introduced commercially into Great Britain, so that the lack of evidence from America in that respect is to be regarded as indicating the improbability of any serious deferred injury. The Committee considers that it would be impossible, and in fact superfluous, to embark on an extensive examination of human subjects in Great Britain, although it proposes to undertake certain confirmatory investigations, and possibly to elucidate some points which have not yet been examined.

EXCEPTION has been taken to the suggestion made at the close of our leading article on "The Museums of the British Isles" (July 14), that the first step in the improvement of the provincial museums should be made by funds independent of the public and the

rates. Mr. J. Reeves writes: 'Does the writer seriously suggest that the supply and maintenance of these institutions should be dependent upon private benevolence, and, as a corollary, that existing museums should not receive further aid from public funds, whether taxes or rates? It is not probable that such a view will be accepted by educationists or by many others.' It certainly was not our idea to suggest that public funds presently available for museums should be withdrawn. On the contrary, more money is urgently required. Where is it to come from? In a democratic country public funds are made available only on the insistent demand of the public or its representatives, and the lack of interest of both are painfully evident in the provincial museums which are crumbling to dust, and in the pitiful sums spent upon the majority of local museums, as Sir Henry Miers's tables show. There is little help to be looked for from this quarter.

ON the other hand, some of the best of the American museums depend upon private benevolence or support, and so also do the most flourishing of the zoological gardens in Great Britain. If our museums could be made as attractive as these, there can be little doubt that the interest of the public and of municipal and county authorities would be aroused, and a new demand would be created for the further development of the educational and recreational facilities of museums, at the public expense. The practical difficulty lies in the first step of this process of up-grading the poorer museums. It demands curators with knowledge and outlook, and, in addition to the salaries of such skilled and rare men, money for upkeep and development. In the present financial condition of the country it would be difficult to induce the Government to give the necessary help to provincial museums; many local authorities have shown how limited is their ability or willingness. What remains but private benevolence? We had in mind not so much the desultory help of the private individual, for unfortunately the wealthy men of Britain have not rallied to the support of museums in the way that the wealthy American has, but rather we envisaged the assistance that might be forthcoming from such a benevolent body as the Carnegie United Kingdom Trust, if it felt assured that its preliminary aid would lead to the permanent and progressive improvement of the provincial museum.

THE director of the Royal Botanic Gardens, Kew, has arranged for Mr. J. Hutchinson, assistant at the Herbarium, Royal Botanic Gardens, and formerly assistant for Tropical Africa, to carry out a botanical tour in South Africa in concurrence with the botanical authorities in the Union of South Africa. Mr. Hutchinson left Kew on July 27, and is sailing to Cape Town by the S.S. *Saxon*. Shortly after his arrival at Cape Town he will proceed to Namaqualand with Mr. Pillans, who has kindly invited him to join him on a collecting expedition in that region. Later he intends to make a tour through the Central Coast Region and pay visits to the Knysna forests, Transkei, East Griqualand, and Natal, and the regions which are especially rich in succulents. In the Transvaal and Swaziland Mr. Hutchinson will be assisted as to his tour by Dr. Pole Evans, and he also hopes to visit British Bechuanaland and the Fauresmith Botanical Reserve. The Karroo Flora will be studied, and the autumn Flora of Table Mountain, before he leaves for home in April. Mr. Hutchinson will be visiting the various botanical institutions and gardens in the Union during his stay in South Africa.

THIS tour, which should result in the introduction of many new and interesting plants and valuable specimens for the Herbarium, has been rendered possible through the grant of the Empire Marketing Board to Kew. The portion of the grant assigned for 'Collectors' has enabled Kew to revert to the old practice which was of so much value in the days of Sir Joseph Banks and Sir William Hooker, of sending botanical collectors to study and bring home to the Royal Botanic Gardens plants of economic or botanical interest. The recent mission of Mr. Howes, assistant in the Museums, to Siam, Malay, and Burma in quest of bananas likely to be immune to Panama disease, which was carried out under this grant, has yielded valuable results.

THE Gas Referees have recently extended the use of continuously recording calorimeters for official testings of the gas supplied in Great Britain, and one or more of such instruments has been or is about to be prescribed by them for every gas undertaking which sells more than 2000 million cubic feet of gas per annum. There are already eleven recording calorimeters in use for official testings, and very shortly the number prescribed will be increased to thirty, of which thirteen will be on the gas supplied by Metropolitan and suburban gas companies, and one each at Birmingham, Bournemouth, Brighton, Bristol, Coventry, Croydon, Edinburgh, Glasgow, Leeds, Leicester, Liverpool, Manchester, Newcastle-upon-Tyne, Nottingham, Portsmouth, Sheffield, and Stoke-on-Trent. Three types of continuously recording calorimeter have been approved by the Gas Referees for use in official testings, namely, the 'Boys,' made by Messrs. John J. Griffin and Sons, Ltd.; the 'Fairweather,' made by Scientific and Projections, Ltd., and the 'Thomas,' made by the Cambridge Instrument Company, Ltd. The instrument provided is, in every case, subjected to preliminary trials by the referees before it is certified for use by the officially appointed gas examiner.

IT is reported that a further transference of between 1000 and 1100 bison has been made by the Canadian Department of the Interior, from Wainwright National Park, Alberta, to Wood Buffalo Park, near Fort Smith, in the North-west Territories. The animals were segregated in corrals during the winter, and, as in former years, were moved partly by rail in specially equipped cars, and by river in scows. The number of bisons transferred from Wainwright to Wood Buffalo Park since the movements were inaugurated in 1925, now exceeds 6600. When these transferences commenced, a protest was made in NATURE against the deliberate commingling of the 'plains' and the 'wood' bison, two distinct racial forms, the latter of

which, the only truly wild bison now surviving, ran the risk of being swamped in the crossing that seemed probable. While it is stated that "wardens report that the buffalo placed in the park since the first movement in 1925 are making satisfactory progress," no reference is made to the effect of the presence of an overwhelming number of a strange race upon the characters and survival of the sole existing herd of wood buffalo—a matter of much greater significance. Private advices received from Canada in the earlier days of the transferences suggested that the imported bison had migrated to parts away from the "wood buffalo" herds, but whether a natural segregation has continued we have no recent information.

IN the United States attempts to make scientific knowledge common household stock become more and more pressing, but whether they accomplish their aim is a different matter. The popular anti-fundamentalist journal *Evolution* has already been referred to in our columns; it is a serious endeavour to inform public opinion as to modern views of life, and at the same time to laugh out of court the absurdities of the 'funnymentals.' Science Service of Washington, D.C., issues weekly radio summaries of new things in science, as well as daily jottings "from Nature's notebook." The latter are short accounts of well-known plants and animals, but it is doubtful whether the non-naturalist public will be willing to absorb such descriptions at the rate of one a day. The weekly radio summary of July 5 consisted of almost four foolscap pages describing "babies that walk like bears," a so-called behaviour atavism, the interpretation of which scarcely seems to have reached a degree of scientific security sufficient to warrant public broadcasting. A highly problematical, but very interesting, speculation is contained in a recent communication from Science Service, under the caption, "The Dinosaurs died of Rickets; Dust from Prehistoric Volcanoes shut off Ultra-Violet Rays from the Sun, and the Big Lizards were wiped out by a Baby Disease." The Smithsonian Institution, to the excellent publicity work of which we have often referred, also has a "Scientific News Service." Here one would expect to find a high standard of attainment, and while on the whole the information is sound and freshly expressed, there occur occasional blemishes, such as "According to a Smithsonian palæontologist, three great groups of backboned animals have attained flight—birds, mammals, and reptiles." This is self-advertisement outraging modesty.

ON July 7 a large gathering of chemists from many countries met in Darmstadt at the invitation of the three Societies, the Deutsche Chemische Gesellschaft, the Verein Deutscher Chemiker, and the Deutsche Bunsen-Gesellschaft, to be present at the formal dedication of the national memorial to Liebig and Wöhler at the birthplace of the former. According to the *Chemiker-Zeitung*, the ancient house in which Liebig was born in 1803 had become so dilapidated in 1920 that it had to be demolished, but by the generosity of chemists and the chemical industry in Germany a replica of the original building has been made. The guests were greeted by Prof. Berl in the Otto-Berndt hall of the Technische Hochschule. Prof. J. F. Thorpe presented an address from the Chemical Society of London, and representatives from France, Denmark, Holland, Japan, Sweden, Switzerland, Spain, and Austria were also present. Prof. Haber delivered an oration, in which he eulogised Liebig's character and dwelt upon the influence of his great personality, his wide culture, his peculiar fitness for the tasks which he undertook, his experimental skill, his imaginative vision, and his masterly command of the German language. This was followed by an appreciation by Prof. Wohl of Danzig, of Liebig's great colleague Wöhler, whose work may be said to have paved the way for the development of modern biochemistry. M. Gabriel Bertrand, of the Pasteur Institute in Paris, also addressed the delegates, who journeyed to Giessen on the following day to visit the Liebig museum there.

IN the United States the new Weights and Measures Bill (H.R. 7208), commonly known as the Tilson Bill, furnished a leading topic for discussion at the twenty-first National Conference on Weights and Measures, which was held at the Bureau of Standards, Washington, during the fourth week of May. This Bill, which aims at establishing a certain degree of Federal control over weighing and measuring appliances, was criticised by delegates representing the American Institute of Weights and Measures on the ground that it constitutes an insidious attempt to drive in the 'pro-metric' wedge, the thin end of which was inserted by the issue of the Mendenhall Order in 1893. The critics of the Bill regard that Order, promulgated by Prof. Mendenhall when Superintendent of Weights and Measures, as *ultra vires* because, having none but departmental authority, and notwithstanding a provision of the constitution which vests solely in Congress the power "to fix the Standard of Weights and Measures," it declared the fundamental standards of the country to be the metre and the kilogram, in place of the yard and the pound respectively, and defined the latter units in terms of the former. They also appear to look upon the Bureau, in spite of its present director's disclaimer, as having pro-metric sympathies and aims, and they therefore wish for the Bill to be amended in such a way as to circumscribe strictly the powers of the Bureau as well as to restore the pre-eminence of the yard and pound as fundamental national standards and to preserve their absolute identity with those of the British Empire. The amounts by which the ratio of the yard to the metre is found to vary on successive comparisons are, from a practical viewpoint, infinitesimal, but the mere fact that the metric *units* are administratively defined as fundamental is feared to furnish a dangerously specious argument for the extended use of the metric *system*, and ultimately for its legislative enforcement.

THE expedition sent by the New York Zoological Society to the Galapagos Islands in the spring of the year has returned safely with its mission fulfilled. Its object, under the leadership of Dr. C. H. Townsend, was to save alive a remnant of the giant tortoises of

the islands, and preliminary reports published in the *New York Times* and *Science* show how desirable that action had become. In the days of Dampier (1864) the tortoises were innumerable; in later times seventy-nine new Bedford whalers carried off 13,000 tortoises, an invaluable article of food. Now the tortoises are extinct on all but two or three of the islands in the group, and Dr. Townsend confirms the reports of recent visitors that the giant tortoise cannot long survive even there, since all the eggs and young are destroyed by wild dogs, pigs, cats, and rats. Once common throughout the islands, the tortoises are now confined to mountainous regions difficult of access to man. The only hope of keeping the stock alive was to establish it in conditions where its safety and continuance could be assured so far as human devices go. Accordingly, the expedition captured 180 live tortoises and, having transported all in safety, it has placed breeding colonies of 15 to 30 individuals at half-a-dozen stations in tropical and sub-tropical Central and North America, in the belief that at some, if not at all of the stations, breeding and successful rearing of young will take place. Since all the captured specimens have been numbered and weighed, the experiment should yield information as to rate of growth and age. A dozen skeletons of the long-extinct tortoise of Charles Island were also obtained by the expedition.

AFTER the conferring of degrees in medicine in the University of Edinburgh on July 18, Prof. W. Wright Smith addressed the graduates on the subject of the place which the physician has held in the world and the position he is likely to occupy in the future. The physician's is no longer merely the healing art; trend of medicine is to the prophylactic. Reference was made to the opinions of doctors held by various writers, medical and lay, and among the latter, Robert Louis Stevenson. Prof. Smith said, though it was possibly not on record that Stevenson ever meditated becoming a doctor, he had it on the authority of his predecessor, the late Sir Isaac Bayley Balfour, that Stevenson began attendance on the class of zoology then held in the summer term. In the practical class the men worked in pairs, and Stevenson and Balfour worked together, and the crayfish was their first venture. The work was divided on the principle that Balfour did the dissection while Stevenson read the details from the text-book. But on the morning of the third day, under their attentions and those of the summer sun, the crayfish lodged a strong protest. With a vivid comment thereon Stevenson departed, and did not again appear in the precincts of the Zoology Department.

DR. FARNELL'S recent lecture to the British Academy on "Hedonism and Art" (London: Oxford University Press, 1*s*. net) deserves some notice by men of science, because, although he does not specifically mention it, the question at issue touches both science and art. As we know, they are closely connected activities of the mind, and in the case of art it has frequently been claimed that the giving of pleasure is its primary object. It is this contention that Dr. Farnell disputes and disposes of. In place of the "flowery tracks of pleasure" he would substitute "sublimity, high-souledness, nobility in sentiment and thought." The conscious reaction to a work of art "in the susceptible hearer or spectator" is certainly not to be called pleasure, but rather "uplift, awe, admiration, consciousness of the higher value of a nobler world than that of our normal self, a world from which the true hedonist is excluded." He illustrates this to good effect from many great works of art, especially from the poets, and his conclusion seems to be sound. For a full discussion, however, much more than a pamphlet of 19 pages is needed, and any such discussion should include the companion sphere of science in which similar, though not precisely identical, considerations would be found to hold good. In each sphere the true goal and the higher sense of achievement is reached just in so far as the work of science or of art enlarges and elevates the spiritual world in which we live. This merging and elevation of the individual in a greater sphere is the true explanation of both, the difference being, as Francis Bacon once put it, that in science, man grows by taking Nature into himself — in art he projects or adds himself to Nature. But Dr. Farnell's lecture deserves a careful reading and contains nothing contradictory to the wider view in which science and art may be seen as complementary and connected aspects of spiritual growth.

THE Littlehampton Nature and Archæology Circle is a thriving local society of 56 members, which has completed its fourth year of existence, and the reports for 1926 and 1927 that we have received show that much important work has been done. Exploration of the low cliff of brick-earth at Kingston has shown, by an examination of the non-marine mollusca by A. S. Kennard, that the lowest bed is a late pleistocene deposit, and it apparently deserves further exploration. An interesting piece of exploration has been done in Arundel Park, at Nanny's Croft, where a Roman road appears to have led down to the River Arun from settlements on the Downs, which thus were linked up with the trade passing up and down the river. The road terminates in a causeway below the river bank. Evidence of iron-melting was found, and some pounds of slag obtained. About 600 feet of trenching was carried out, and many fragments of Roman pottery, tiles, bricks, and four coins of Constantine I., Valentian I., etc., were found, the date of the occupation of the site being thus approximately the fourth and fifth centuries. The remains of bones found also indicate, according to Sir Arthur Keith, Roman age. There were no Saxon or Norman remains. The report also contains bird-notes, from which we note a sight of a peregrine falcon on the Arun, a supplementary list of local flowers, and a short description of the Old Manor-House at Rustington, the frontispiece to the volume being an illustration of the timber-work of the formerly concealed west front.

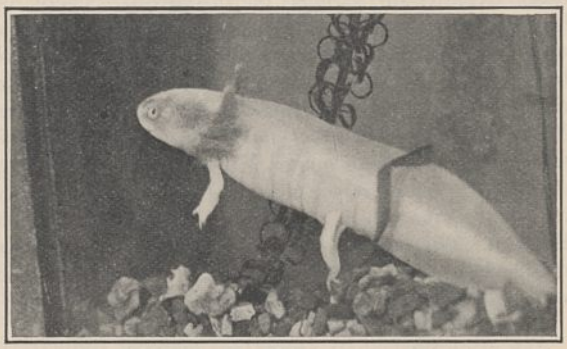
THE greater part of the inaugural address on "The Impact of Science upon an old Civilisation," given by Prof. F. Soddy at University College, Aberystwyth, in October last, has recently been

published by Messrs. Hendersons, 66 Charing Cross Road, London, as a pamphlet (price 6*d.*). The pamphlet epitomises Prof. Soddy's views on the monetary system of the civilised world which he dealt with exhaustively in a recent volume. In his opinion, that system was attuned to the principle of scarcity upon which he alleges our civilisation is still based, in spite of the fact that the impact of science upon productive processes has made possible the easy satisfaction of the necessities and essentials of a healthy and abundant existence for a far greater population than the world supports to-day. The fact that 'sufficiency' has not been realised he attributes to the persistence of an antiquated non-scientific orthodoxy in the spheres of economics and finance. "Our [present] civilisation demands and, through its financial system, issues an edict," he says, "that there shall be no production unless there is a willing and solvent debtor to owe for the product."

SOCIETY, Prof. Soddy states, befogged by the reiteration of the static beliefs of those steeped in the classical tradition, is still apparently unaware of the cause of present discontents, although made uncomfortable by its symptoms, or that it is drifting rapidly towards the abyss. It fails to realise that the proper function of a monetary system is to facilitate and expedite the interchange of goods and services and not the enrichment of private usurers. Nevertheless, there is a quickened interest in the matters dealt with in Prof. Soddy's pamphlet. There are even rumours of the possibility of a Royal Commission on Finance. If there were more scientific workers like him, prepared to approach the problems facing society in the same spirit as they approach their specialised studies, the civilised world might possibly be stirred from its complacent indifference to the urgent need for a critical investigation of the present system.

ON the occasion of the annual meeting of the British Medical Association at Cardiff on July 20–28, the Wellcome Historical Medical Museum has published an announcement, accompanied by numerous illustrations, of the "History and Lore of Cymric Medicine," which is to form the next addition to the Research Studies in Medical History issued by the Museum. The forthcoming work claims to be a trustworthy source of information for students, research workers, and all those interested in the evolution of medicine from the most primitive times. The book will contain a full description of ancient medical lore in Wales from the palæolithic period onwards, and will include translations of the celebrated medieval Welsh manuscript known as Meddyon Myddfai. The results of the study of the chronicles of epidemics from the earliest times are to be recorded, as well as the history of healing wells, charms, amulets, and talismans connected with Cymric medical lore. A section is devoted to the Cardiff medical school, with a biographical review of notable Welsh doctors. Members of the medical profession and others possessing books, manuscripts, and other useful information on the subject of the history, folklore, and legends dealt with in this work are requested to communicate at once with the Conservator of the Wellcome Historical Medical Museum, 54 Wigmore Street, W.1.

THE British Aquarists' Association Exhibition was held at Trinity Hall, Great Portland Street, London, W.C.1, on July 24–28. There were about 600 exhibits, including some very rare specimens, such as white orandas, which are the highest point in the hybridisation of the fancy goldfish, the harlequin-hued shubunkin, and telescopic-eyed veiltail, and grotesque black telescopic-eyed veiltail. There were also specimens of *Copeina Arnoldi*, the male and female of which leap out of the water when spawning, and the eggs are laid on the side of the aquarium about two or three inches above the surface; after completing spawning, the male drives the female away, and splashes the eggs with water with his tail. Another interesting fish was the climbing African perch, which is able to propel itself on land by means of its pectoral fins in search of water in the event of drought. Other exhibits included the angel fish, the aristocrat of all



Photo] [*E. C. Le Grice.*

FIG. 1.—Albino axolotl.

aquarium fishes, fine lizards, and Japanese tree frogs, which arrived from Yokohama, via Siberia, by letter post in a tobacco tin, and dwarf chameleons. The 'best fish' in the exhibition was judged to be white oranda, owned by Dr. H. B. Jones; and the 'best reptile,' a pair of axolotls shown by Mr. H. Whitley. A noteworthy feature of the show was the stall by Mr. Amos Perry, Enfield, on which were shown many beautiful *Nymphæ*, and other rare plants. The pond life exhibits, with their minute aquatic insects and other creatures, also created much interest. One fish, a blue telescopic-eyed veiltail, was sold for £100. The whole arrangement of the show was to demonstrate that fish can be kept in aquaria, and will live there if only reasonable precautions are taken. Mr. A. W. Croser, the Hon. Secretary of the British Aquarists' Association, 12 Winkfield Road, Wood Green, London, N.22, will be glad to give information on home aquaria, etc.

MR. A. PAGE, the chief engineer to the Central Electricity Board, in the course of an interesting paper on the electric transmission of power, read at the recent centenary conference of the Civil Engineers, pointed out that the ideal to be aimed at is to make electricity available without restriction throughout Great Britain. The system chosen, therefore, must

be extremely flexible, so as to make the supply trustworthy and reduce the charges to the consumer. Since the price of the coal used for the boilers varies very little in different localities, there is a wide choice of suitable sites for power stations. As many of these sites have already been developed, the problem resolves itself into selecting the best of them for association with the 'grid.' The voltage and carrying capacity of the grid lines have been fixed at 132 kilovolts and 50,000 kilowatts respectively. It is interesting to know that in New York and Chicago there is now a considerable length of line operating at 132 kilovolts. The conductors are of aluminium, with a steel core, and their size is such that there is little risk of brush discharge taking place even under the most unfavourable weather conditions. After a careful study of the effect of foggy salt-laden atmosphere on high tension insulators, it was decided to use suspending strings containing nine of them in series. Induced voltages in the line due to lightning flashes in the neighbourhood are very unlikely to flash over these strings of insulators. There is, however, no certain way of escaping the consequences of a flash striking the line directly. Methods have been developed for disconnecting faulty lines for repair without interrupting the supply. One point Mr. Page emphasised was that the main function of the grid lines was to act as interconnectors, and not merely for power transmission. Hence they had only to carry a fraction of the energy generated in Great Britain. The percentage energy losses in these mains, therefore, would be practically negligible and would diminish as the load developed.

We are informed by Imperial Chemical Industries, Ltd., that Dr. E. F. Armstrong, having resigned his position as a director of British Dyestuffs Corporation, Limited, has accepted a retainer as consultant to Imperial Chemical Industries, Ltd.

Mr. J. G. Pearce, director of the British Cast Iron Research Association, has been unanimously awarded by the judges the first prize of 100 guineas for a series of practicable proposals relating to 'Goodwill in Industry.' The competition was organised by the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, and the judges represented the three parties in industry—the employer, the worker, and the technical or administrative officer.

The Department of Zoology of the British Museum (Natural History) has received an important collection of mammals and birds obtained by a Franco-British expedition to French Indo-China under the leadership of M. Jean Delacour, with whom was associated M. Pierre Jabouille. The collection comprises 151 mammals and 1794 birds: of these, three mammals and twelve birds are forms new to science and are therefore of considerable systematic interest.

It is announced in *Science* that Thomas A. Edison, John J. Carty, Michael I. Pupin, Ambrose Swasey, and Elihu Thomson have been elected honorary members of the American Institute of Electrical Engineers. This is the first time that any American honorary members have been elected.

The *Medical Press and Circular* (8 Henrietta Street, London, W.C.2) is now issuing quarterly a "Literary Number," a feature of which is a bibliography of medical books published during the previous three months. The bibliography is comprehensive and is designed to cover the literature of the medical and allied sciences of the whole world. The second literary number was published on July 11.

The McGraw-Hill Publishing Co., Ltd., has issued a useful list (No. 13) of books on mathematics and physics, the mathematics section including advanced and practical or engineering mathematics. Each title is accompanied by a brief note on the style and scope of the book and a list of the chapter headings, so that it is possible to judge quickly as to the suitability or otherwise of any book for a particular purpose.

The appearance of a third edition of the illustrated handbook on the house-fly, by Major E. E. Austen (British Museum (Natural History), Economic Series 1A, 1928; 1*s*.), affords ample testimony to its utility. Although only two years have elapsed since the publication of the last edition, new discoveries of importance have been made, and with these facts in mind its text has been thoroughly revised. We commend this excellent publication to all interested in public health and fly suppression. It is obtainable through booksellers.

The U.S. Coast and Geodetic Survey has issued, as *Special Publication No. 139* (price 20 cents), a useful booklet of 78 pages entitled "Instructions for Tide Observations," by G. T. Rude. It summarises for field purposes the methods used by the Survey in obtaining tide observations, and in making the reductions of the tide records necessary for the establishment of planes of reference for reducing the soundings of a hydrographic survey. Being intended as a working manual, the methods of computation described are restricted to those required for field use, and no theoretical discussions are included.

The Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, has organised an "Anti-Malarial Advisory Committee," with the object of assisting tropical industries in carrying out practical measures to combat the disease. The technical members of the committee are Sir Malcolm Watson, Sir Ronald Ross, Sir William Simpson, and Sir Aldo Castellani, and the lay members include representatives of a number of rubber, cotton, gold, and other mining companies and associations. The anti-malaria staff at the Institute will be at the disposal of these companies for advice, and it is intended that Sir Malcolm Watson himself shall visit some part of the tropics every year for a short period.

Applications are invited for the following appointments, on or before the dates mentioned:—A part-time evening lecturer and instructor for carpentry

and joinery at the Acton Technical Institute—The Principal, Chiswick Polytechnic, Bath Road, Bedford Park, W.4 (Aug. 8). An assistant master to teach mechanical engineering subjects to junior technical pupils and evening adult students at the Redhill Junior Technical School—The Clerk to the Governors, Education Office, Municipal Buildings, Reigate (Aug. 8). A junior technical officer in an Admiralty Experimental Establishment the work of which consists mainly of design in connexion with acoustical and electrical apparatus — The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Aug. 11). A wood workshop instructor for the Junior Technical School of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Aug. 15). A research chemist under the Safety in Mines Research Board, for the study of ionisation during gaseous explosions — The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Aug. 18). A woman demonstrator and assistant lecturer in the department of chemistry of the Royal Holloway College — The Principal, Royal Holloway College, Englefield Green, Surrey (Aug. 30). A physics graduate at the Northampton Polytechnic Institute, partly for teaching and partly for research in ophthalmic optics—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (Aug. 30). An assistant lecturer and demonstrator in the British School of Malting and Brewing and department of the Biochemistry of Fermentation of the University of Birmingham—The Secretary, University, Birmingham (Aug. 31). Two chemists for the Meat Products Research Branch of the N.Z. Department of Scientific and Industrial Research, Wellington—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Sept. 8). A chief assistant entomologist at the Rothamsted Experimental Station — The Secretary, Rothamsted Experimental Station, Harpenden, Herts (Sept. 15). A lecturer in biology at the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth. A head of the mechanical engineering department of the Darlington Technical College—The Chief Education Officer, Education Office, Darlington. A head of the Junior Technical School of the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A principal of the North-Western Polytechnic (now being erected)—The Clerk to the Governors, North-Western Polytechnic, 3 Temple Gardens, Temple, E.C.4. A laboratory assistant in the Department of Agriculture and Forests, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1.

Our Astronomical Column.

MAGNETIC STORMS AND SUNSPOTS.—Under the title "Large Magnetic Storms and Large Sunspots," in *Monthly Notices Royal Astron. Soc.*, May 1928, W. M. H. Greaves and H. W. Newton discuss the occurrence of sunspots at the time of magnetic storms for the 54 years 1874–1927. Magnetic disturbances are included for which the range in declination was at least 1°, or that in H.F. or V.F. at least 300 γ. Sunspots of mean area 500 millionths of the sun's hemisphere or greater are considered significant in a comparison with magnetic storms. The analysis shows that out of 60 magnetic storms, 36 commenced within 4 days of the central meridian passage of a large spot (chance would give about 17 coincidences between spot and storm); 8 other storms commenced within 4 days of the central meridian passage of a region of the sun which had previously been markedly disturbed; in 7 other cases the storm was followed one solar rotation later (about 27 days) by the transit of a large spot which had developed in the interval; the remaining 9 storms occurred when neither spots nor faculæ were unusual. When the largest magnetic storms were examined ($D \geq 1\frac{1}{2}°$ or H.F. or V.F. $\geq 500\,\gamma$), it was found that 15 out of 17 storms occurred in conjunction with a large spot; the sixteenth storm took place one solar rotation after the central meridian passage of a large spot, while the seventeenth storm preceded by one solar rotation the central meridian passage of another large spot (see NATURE, May 26, p. 842). These figures show that individual storms and individual spots are associated with each other more often than can be ascribed to chance, and that the tendency to association is greater for the largest storms.

Little evidence is found of a tendency for these magnetic storms to recur one solar rotation later. This is not necessarily in contradiction to Maunder, who found a definite tendency for magnetic disturbances to recur about 27 days later (*Monthly Notices R.A.S.*, pp. 19-22, etc.; 1904). The present authors have collected data for the period 1874–1927 relating to smaller storms (such as were included by Maunder in his analysis), and a discussion of this class of magnetic disturbance may show a more definite recurrence phenomenon.

SATURN'S SATELLITE HYPERION.—This satellite has attracted the special attention of dynamical astronomers owing to its large perturbations by Titan, and the fact that the mean motions of the two are nearly commensurable, in the ratio of 4 to 3. The *Annals of Leiden Observatory*, vol. 16, Part 3, contain a new investigation by J. Woltjer, Jun. He gives a revised theory, and a comparison with observations from 1875 to 1922; also tables for computing the motion as perturbed by Titan.

The discussion affords three different determinations of the mass of Titan, from the motions of (1) the argument of libration, (2) the longitude of peri-centre, (3) the node. The values of the reciprocal of the mass, compared with that of Saturn, are 3986, 4080, and 3767 respectively; combining these with values found by Brouwer, Eichelberger, and Samter, he adopts the weighted mean 4033. This makes the mass of Titan 1·9 times that of our moon, but its density is only about half that of the moon.

The comparison with observations brings out the superiority of the method of comparing one satellite with another, rather than with Saturn itself. The latter method was used up to 1887 and gave for the mean error of one observation values that ranged from $\frac{1}{2}''$ to $\frac{3}{4}''$; the other method was then introduced by Struve at Pulkovo and reduced the mean error of an observation to $\frac{1}{4}''$.

Research Items.

PREHISTORIC CULTURE OF THE COLUMBIA RIVER, U.S.A.—In vol 73, art. 11, of the *Proceedings of the U.S. National Museum*, Mr. H. W. Krieger describes the results of an investigation of a prehistoric pit-dwelling village at Wahluke, Grant County, Washington, which was undertaken as part of a general survey of the Columbia River area with the view of determining the character of the culture of its early inhabitants and its relation to neighbouring cultures. The area is of considerable importance ethnologically, as the Saddle Mountains form a barrier dividing Salish from Shahaptian-speaking Indians. Geologically, the formation makes it possible to determine without question that man could not have inhabited the area in pleistocene times, and that the relics of early man attributed to pleistocene deposits or associated with pleistocene faunal remains are intrusive. The culture of the pit-house village is especially interesting, as indicating the exhaustive manner in which the inhabitants exploited the natural resources of the area, more particularly in the development of their stone culture, no less than twenty-five varieties of stone being enumerated, of which they made use in the manufacture of tools and implements. It is to be noted that all forms of the stone axe were lacking in the surface finds and among the grave offerings; the inhabitants of Wahluke depended on the hafted discoidal stone war club, the flaked hammerstone, the grooved maul, and the stone wedge in its stead. The cemetery contained both primary and secondary burials, but practically no other type than that of ceremonial burial. A few skulls were recovered from among the remains. These showed artificial deformation, and the occipital flattening due to the use of an uncovered cradle board. The frontal occipital flattening was produced by a cradle board flap similar to that used by Columbian Indians in historic times.

A THEORY OF THE SMILE.—In *Psyche* (vol. 8, No. 4) Mr. A. M. Hocart develops a theory of the smile. He points out that the origin of the smile does not seem to have been satisfactorily explained by psychologists. Even Prof. Wm. McDougall, who explained the laugh as a protective reaction (NATURE, vol. 67, 1903) left the smile on one side. A search among other animals may furnish some clue. When a dog is pleased, especially when it is full of fun, it opens its mouth slightly, draws back the corners of the mouth, and bares its teeth. If one tickles it under the arm pits as it is lying, it is apt to draw back the corners of its mouth slightly without baring its teeth. A puppy welcomes its master with its ears cocked, a distinct gleam in its eyes, wagging its tail and smiling. As its master draws nearer, it rushes toward him and proceeds to chew his hand. The smile then may be the resultant of two opposite tendencies, the impulse to tear with the teeth and the impulse to suck and lick the object of affection. Adult man does not habitually bite the object of his affection, but there is a tendency that way which usually betrays itself only in words; in children there is a distinct tendency to chew affectionately. This tendency is in man early repressed and only breaks out into action under the stress of violent emotion. The parallel between the man's smile and the dog's is so close, that they may be identified, the differences being due to man's more complex development. The author offers these suggestions in the hope that they may stimulate research into the question. Darwin in his "Expression of the Emotions" related the smile to the expression of pleasure in sucking.

DEATH AND EVOLUTION.—In former papers Prof. Raymond Pearl has suggested, from statistical analyses, that the different organ systems of the human body are not all equally capable of withstanding disease, and that the distribution of human mortality is associated with the evolutionary history of the human body. A further study suggests that the incidence of disease in various organ systems has an evolutionary significance throughout the vertebrate series (*Quart. Rev. Biology*, vol. 3, June 1928, p. 271). His animal statistics are drawn from the records of deaths at the Gardens of the Zoological Society of London for the four years 1920–23, 4448 deaths in all. The predominant causes of death amongst vertebrates, including man, are associated with the alimentary, the respiratory, and the circulatory systems in the order named, and of these the first two are by far the most mortal. But whereas there is a decreasing ratio of alimentary fatality from reptiles to birds and from birds to mammals, the order is reversed in the case of the respiratory system. It would seem, therefore, that while the evolution of the respiratory system has made it more and more vulnerable to the attacks of disease, the alimentary system has gradually attained a greater disease-resistance. Again, if the incidence of deaths be tabulated according to the primary germ layers from which the organs arose, it is seen that in all vertebrate groups, including man, the endoderm series is most vulnerable, the ectoderm series least vulnerable. Further, whereas the ratio of deaths associated with ectodermal organs increases from the lowest to the highest vertebrate, the order is exactly reversed in the case of endodermal organs. Although the nervous system does not stand high in the incidence of death, it is interesting to note that in civilised man its vulnerability is enormously greater than in any other vertebrate group, the ratios, from 100 deaths in each group, being, reptiles 0, birds 0·12, mammals 0·64, man 8·91.

FOREIGN BIRDS ESTABLISHED IN NORTH AMERICA.—A summary of all the facts that can be learned about the introduction or transplantation of birds in North America has been compiled by John C. Phillips (*U.S. Dept. Agr. Tech. Bull. No. 61*, April 1928). The list contains the names of a wonderful variety of birds, from tinamous to sparrows, but relatively few of the many have succeeded in forming permanent colonies. Some were mere escapes from captivity, which had little chance of survival, but even amongst the birds deliberately planted in the new land, for their beauty, their value as songsters, or their sporting qualities, there were many failures. Some, such as the capercaillie, black game, and many European songbirds, vanished almost as soon as they were liberated; others nested for a season and then declined, although all the conditions seemed favourable for survival; still others, for example, the European skylark and goldfinch, survived and bred for a term of years and then disappeared; only a small minority of forms found conditions so favourable that they settled down and multiplied. The English house-sparrow, the starling, the pheasant in Massachusetts, and the partridge in the north-west have been extraordinarily successful colonisers; but as a rule the first outburst of success is soon checked by natural causes, and a fresh balance is established. It has even happened that an alien, at one period so prolific as to be regarded as a pest, has entirely disappeared when Nature has had time to bring her opposition forces into line.

BIOLOGY OF THE OYSTER AND OTHER LAMELLIBRANCHS.—In the April number of the *M.B.A. Journal* (N.S., **15**, 2), J. H. Orton finds that shell-growth, fattening and breeding of *Ostrea* are mainly governed by temperature. He is thus able to describe three types of environment by reference to which most oyster beds may be defined. Many other aspects of the oyster's internal and external economy are discussed. C. Amirthalingham investigates the state of sexual maturity of *Pecten*, which undergoes changes having a well-defined lunar periodicity. C. M. Yonge combats the view that *Ostrea* can absorb soluble substances directly through the superficial epithelium. He shows that the appearance of this phenomenon in the experiments of other workers is almost certainly to be attributed to the action of leucocytes liberated on the epithelia in 'bleeding,' which is liable to occur in unfavourable conditions. A. C. Stephen gives a general account of the biology of *Tellina tenuis* in Cumbrae bays.

PARASITISM AS A SEX-DETERMINING FACTOR.—In the *Official Record U.S. Department of Agriculture* (vol. 6, No. 43; 1927) is an interesting account by N. A. Cobb, G. Steiner, and J. R. Christie of observations on the nematode *Mermis subnigrescens*, a common parasite of grasshoppers. These became parasitised by swallowing the eggs of *Mermis* which had been deposited on the food-plant of the grasshoppers. The infective egg contains a well-developed worm. In thousands of observations the average number of worms per infested grasshopper in Nature was from one to three, and always females. Females, in the absence of males, can produce viable eggs which give rise to infective larvæ. Experiments were made to determine the dose of eggs of *Mermis* that would be fatal to the host, and for young grasshoppers in the second instar this was found to be well under fifty eggs. When a slightly sublethal dose of eggs was given all the resulting worms were males; *e.g.* 20 *Mermis* eggs were fed to a grasshopper previously free from this parasite, and the resulting 19 worms were all males, whereas feeding with a very few eggs resulted in female worms. Corresponding observations on a *Pseudomermis* in the larvæ of a midge (*Chironomus*), on an *Agamermis* in the tea bug (*Helopeltis*), and on an *Allomermis* in the common ant (*Lasius niger*), showed that when the parasitism was high the worms were males, and when low were females. Between these extremes were gradations, the proportion of males varying with the severity of the parasitism. The authors consider that here is a case where environment is a sex-determining factor which becomes potent not during the early embryology of the worm but after a well-developed, highly differentiated larva has been formed.

TRICHOMONAS HOMINIS.—Robert Hegner (*Jour. Amer. Med. Assoc.*, 90; 1928) records experiments on *Trichomonas hominis* from the intestine of man, on *T. buccalis* from the mouth of man, and on six other species from monkey, cat, rat, chicken, and frog. Twenty-one tubes of serum-saline-citrate medium were inoculated with each of the eight species of *Trichomonas* and immediately fresh blood was added, three drops to each of three tubes, from man, dog, cat, rabbit, rat, guinea-pig, and mouse, and the material was incubated for twenty-four hours except in the case of the trichomonads from the frog, which were examined at the end of five hours. Every species of trichomonad ingested red cells from each of the seven species of mammals; the number ingested by any one trichomonad varied from one to seven. *T. hominis* from the mouth of man ingested the largest number of red cells; of those offered rat's blood, 96 per cent had ingested one or more red cells. The data suggest that the larger the size of the red cell the more difficult is it for the trichomonads to ingest it. The author concludes that the species of *Trichomonas* accept red cells as food just as they do other food particles (*e.g.* bacteria and organic debris) and is not to be regarded as evidence of pathogenicity. In another paper (*Amer. Jour. Hyg.*, 8, No. 1; 1928) Prof. Hegner examines the viability and transmission of *T. hominis*, which has no cyst stage in its life cycle and hence must pass from host to host in its trophozoite phase. The results indicate it is highly improbable that the cockroach ever serves as a transmitting agent, but that flies fed on infected material, from twenty minutes to four hours afterwards, deposit fæces or vomit drops containing living *Trichomonas*.

LIMITING VITAL FACTORS IN FRESH AND SEA WATER.—In an article entitled "Die biologische Bedeutung der Salzkonzentration der Gewässer (*Die Naturwissenschaften*, Heft 14, 229; 1928), C. Schlieper gives an interesting account of some of the physical causes of the poverty of the fresh-water fauna compared with that of the sea. The importance of osmotic pressure is considered first, especially the well-known dependence of the osmotic pressure of the body fluids of marine invertebrates on the external osmotic pressure. But as Beudant showed so long ago as 1816, many typically marine organisms can withstand gradual change to completely fresh-water conditions, and, therefore, osmotic pressure alone does not seem to be the most serious factor in preventing migration from the sea to the fresh water. By comparing the morphological differences between fresh-water and marine organisms, the author makes the suggestion that organs of respiration are more highly developed under fresh-water conditions. He concludes that respiration itself is more difficult in this case, and that this is the true limiting factor which determines existence in fresh water and the sea. This factor might be due to difficulty of oxygen absorption or of carbon dioxide excretion. The quantities of oxygen dissolved in equivalent volumes of salt and fresh waters are not seriously different, and oxygen cannot, therefore, be a limiting factor. It is considered that the chief factor is the ease with which carbon dioxide can be excreted and that this is related to the greater bicarbonate content of sea as opposed to fresh water. This is an interesting suggestion, but physically the fresh water and marine environments differ so fundamentally that it seems impossible to ascribe their faunistic differences solely to a single factor such as this. The immense variability of temperature, *p*H, etc., and the geological inconstancy of fresh water as opposed to the sea, must also be factors of prime importance.

CULTIVATION OF PERENNIAL COTTON IN EGYPT.—In the most important cotton-growing countries, the plant has for years been cultivated almost exclusively as an annual. It must not be forgotten, however, that it is a true perennial in habit, and in almost all countries where it was cultivated it was originally treated as such. The voluminous literature on the subject deals almost entirely with the behaviour of the plant in its first year, but quite recently a controversy sprang up in connexion with perennial cultivation. The majority of the authorities is against the practice for a variety of reasons, chief of which are that the quality of the fibre is held to deteriorate after the first year, and that plants left in the ground more than one year will carry insect pests over the winter, and so result in increased attack. In a recent paper, Dr. J. Templeton has brought together a mass of evidence relating to perennial cultivation of cotton in

various parts of the world, and also describes experimental work carried out in Egypt (*Bulletin*, No. 75, Technical and Scientific Service, Ministry of Agriculture of Egypt). The evidence of the experiments as regards staple quality of first pickings is on the whole definitely against the theory that deterioration takes place after the first year. In addition, the 'ratoon' is of a higher class than the first year cotton. Second-year plants cannot carry the insect pests of cotton in Egypt over the winter, and suffer less damage from insect pests in general than first-year plants. The flowering curve of the second-year plants rises more rapidly and reaches a maximum much earlier than that of the first year, thus shortening the useful flowering period, which has an important bearing on the possible damage to the crop from pink boll-worms. The cost of cultivation is also less, no seed being required in the second year and no sewing, resowing, or thinning. Lastly, given pure seed to start with, the crop will remain pure longer.

MINERALS OF SOUTH AUSTRALIA.—The *Half-Yearly Mining Review*, issued by the Department of Mines of South Australia for the half-year ending Dec. 31, 1927, states among the general notes that a new geological map of the State has been printed and is now available. Owing to the fact that it is many years since a previous edition was published, the present map contains much new information, the plotting of the pre-Cambrian rocks being especially important, because the great majority of the mineral deposits of the State occur in this formation. There is also a short notice of the new method of geophysical prospecting, which is to be tried out in Australia under an arrangement between the Empire Marketing Board and the Commonwealth Council for Scientific and Industrial Research. The general indications given by a geophysical survey and their limitations are clearly explained. It is shown that this method gives indications which can be usefully followed up by drilling or other methods of definite exploration, and the point is stressed that a geophysical survey cannot by itself record the presence of any particular kind of ore, and above all cannot indicate the existence of rich ore until the presence of such ore has been actually proved by drilling. The most interesting feature in the statistical returns is the steady increase in the production of iron ore, which has now reached nearly three-quarters of a million tons, and the value of which is rather more than half of that of the total mineral production of the State.

CATHODE PHENOMENA. — Prof. Güntherschulze points out in the issue of the *Zeitschrift für Physik* for July 4 that the usual assumption that the least potential at which a Geissler discharge can be maintained on a cold cathode is independent of the pressure of the gas, is based upon very scanty evidence, and some new measurements made by him with a massive iron cathode shew that it is by no means always true. Helium, neon, argon, oxygen, and air do certainly exhibit a remarkable constancy of the minimum cathode fall in potential, although there is a small systematic rise for the first three gases with decrease in pressure, but with nitrogen and hydrogen, changes of the order of a hundred volts occur between pressures of one-tenth of a millimetre of mercury and five millimetres of mercury, and it is obviously difficult to attempt to correlate the discharge constants with the thermionic and photoelectric properties of the cathode in such cases. Prof. Güntherschulze's measurements were not made by the accurate but laborious method of exploring electrodes, but there can be little doubt that his results are substantially correct.

SOUND-PROOF ROOMS.—In developing transmitters and apparatus for sound reproduction it is necessary to work in a room which is practically sound-proof. Formerly the walls of rooms were deadened with hair, felt, and other absorbing materials, but the result was not good. Recent theories of sound absorption have shown where the old methods were unsatisfactory. In addition, celotex, a new building material made of matted vegetable fibre and commonly used for heat insulation, has been found to be an excellent absorber of sound. The sound-proof rooms of the Bell Telephone Laboratories of New York are described in their *Record* for June. The rooms are first made with brick walls four inches thick, covered on both sides with hard cement plaster. This structure has a minimum tendency to resonate and a maximum tendency to reflect sound. The doors are built of two thicknesses of $\frac{1}{4}$-in. steel plate, separated by an air space, and are fastened by clamps similar to those used on water-tight bulkhead doors. Inside the masonry wall, and separated from it by an air space, is an inner room built of wood and covered with celotex, separated from the wood by a sheet of metal $\frac{1}{16}$ in. thick, inside which are four successive layers of celotex. The room is supported on as few wooden blocks as possible. In practice it is found that the smallest opening permits the passage of sound. Outer and inner doors, therefore, are arranged so that they are clamped against cushions of rubber foam. To provide the necessary ventilation a labyrinthine duct runs to each of the rooms. Thirteen rooms have been constructed in this way. So far as sounds of fairly high frequency are concerned, they are sound absorbent, but sounds of low frequency are transmitted through the entire structure. The more nearly sound-proof the room is the more sensitive do listeners become to slight sounds. In the present state of our knowledge, an absolutely sound-proof room seems to be impracticable.

CRYSTAL STRUCTURE OF IODINE.—Comparatively few of the non-metallic elements have had their crystal structures elucidated by X-ray analysis, although in the case of non-polar substances such information is especially interesting in connexion with the existence of molecules in the crystals. An investigation of the atomic arrangement in the iodine crystal by the Laue, oscillating crystal and powder methods has been carried out by P. M. Harris, E. Mack, and F. C. Blake, and is described in the *Journal of the American Chemical Society* for June. The unit cell of the ordinary form of iodine has orthorhombic bipyramidal symmetry and was found to contain eight atoms. Its dimensions are $a_0 = 4{\cdot}795$ A., $b_0 = 7{\cdot}255$ A., $c_0 = 9{\cdot}780$ A. The atoms are grouped in molecules of I_2, the distance between the centres of the two atoms in one molecule being 2·70 A.

BORIC ACID ANHYDRIDE AS A DRYING AGENT.—The use of boric acid anhydride for the removal of water has occasionally been advocated, and in the *Journal of the American Chemical Society* for June, J. H. Walton and C. K. Rosenbaum describe an investigation of its efficiency as a drying agent. The temperature of dehydration of the boric acid was found to be an important factor, and if heated above 800° the product showed an induction period before the absorption of moisture began, indicating the probable formation of molecular complexes as suggested by Myers. Boric oxide appears to be a more powerful drying agent than sulphuric acid and calcium chloride, but is inferior to phosphorus pentoxide and magnesium perchlorate. It remains efficient until the water content rises to about 25 per cent of its own weight, this amount of water corresponding approximately to that required for the formation of metaboric acid. The glassy boric acid anhydride is more easily ground if it is obtained granular by pouring in the fused state into carbon tetrachloride at 0°.

The Twelfth International Geographical Congress.

THE twelfth International Geographical Congress, after several days in London devoted chiefly to social functions, met in Cambridge on July 17–25 for the communication and discussion of papers. The president was General N. Vacchelli, and the vice-presidents were General Gomez Nuñez and Prof. N. Yamasaki. Three commissions appointed by the International Geographical Union at a previous congress presented reports. These were on: (1) the International map on the scale of 1 : 1,000,000; (2) rural habitation; and (3) Pliocene and Pleistocene terraces. The first of these has completed its work, but the other two have still a considerable amount of work to undertake, that on terraces comprising only a study of certain European seaboards. Another report presented was on internal drainage areas, which was accompanied by a map prepared by Prof. E. de Martonne and L. Aufrère. The papers were grouped into six sections. Some of the sections were very full, while others, notably biological geography, had few papers.

In Section A (Mathematical Geography, Surveys, and Maps) papers were read on two important new atlases. The International Atlas of the Touring Club of Italy, described by Prof. G. Bognetti, will have English, French, Spanish, and German translations, besides the original Italian edition. The New Atlas of Egypt, described by Hussein Sirry Bey, has the whole country on the million scale and several new climatic and population maps.

In Section B (Physical Geography) a number of papers on climatic changes included one by Prof. J. W. Gregory, in which he argued that the evidence of physical geology and palæontology showed that the climate of the earth has been remarkably stable throughout the past. Geology gives no evidence of a uniform climate over the whole earth, and the claims for tropical conditions in the Arctic, based on fossil plants, are inconsistent with the cold sea of the contemporary marine deposits. He held that geographical changes in the distribution of land are adequate to account for local changes in climate that may have occurred.

Prof. J. L. Myres, in a paper on the climate in prehistoric Greece, found evidence of considerable variations in temperature and humidity in the past from movements of peoples as deduced by ethnology, and changes in architecture and clothing. Prof. G. B. Barbour, speaking on the nature and origin of loess in China, said that the confusion surrounding the problem of the origin of loess has arisen from a failure to distinguish between three types of superficial deposit: (1) Tertiary residual clay; (2) true loess of middle Pleistocene, a wind-driven deposit; and (3) younger gravel and loess beds in process of formation by the action of wind and water. Only the finest material has been carried from the interior of Asia across the frontier of China. Coarser debris is fixed by the vegetation of the mixed marginal belt.

In a paper on the tilting of the land blocks in Japan, Prof. N. Yamasaki described his measurements of movements in the littoral province of Echigo on the coast of the Sea of Japan, where two mountain blocks are separated from each other by a low plain of depression. Precise levellings were carried out in 1894 and 1927, and showed that both the blocks had subsided, during the interval, 2 mm. to 113 mm. The depression decreases from west to east until it reaches its minimum near the east end of each block and then increases suddenly to its maximum. Thus the movement is a tilting with the scarp in the east. This scarp coincides with a pre-existing fault.

Prof. P. Fourmarier spoke on the origin of the hydrographic system of the Congo. This cannot be adequately explained as the progressive draining of a great basin. It is the outcome of complex tectonic movements beginning in Jurassic times by the elevation of a ridge separating the Congo basin from that of the Zambezi, and later by the elevation of ground to the north and east of the basin, thus forcing the water to flow west. Com. L. Mancini explained the active steps that are being taken by Italians in oceanographical and geophysical researches in the Red Sea.

In Section C (Biological Geography) the papers dealt mainly with zoological distribution. Prof. G. Negri urged the importance of further study of the ecology of plants and animals in mountain areas, and the section was in favour of a committee being appointed to investigate this matter and report to the next congress.

Section D (Human Geography) was opened by Sir Halford Mackinder, who in a short address on the content of philosophical geography restricted the study to the distribution of phenomena within the limits of the hydrosphere, that is to say, the totality of waters on the earth, whether in ocean, air, clouds, glaciers, rivers, or percolating underground. Prof. M. Amer discussed some problems of the population of Egypt. The change from the old basin system of irrigation to the perennial system has made Egypt dependent on a single crop, cotton, and led to the necessity of importing foodstuffs. This change has been accompanied by a rapid increase in population, so great that all available land will be occupied by the seventies of this century. The rate of increase is exceeded only by that of the United States. In discussing the causes of rural depopulation, Dr. S. Vere Pearson directed attention to the loss of nitrogenous fertilisers of human origin which through the introduction of water carriage system of sanitation are lost to the soil. Thus the natural fertility of the soil is decreased.

In Section E (Historical Geography) there were a number of useful papers on the history of cartography and old maps. Section F was devoted mainly to regional geography. One of many valuable papers was by Dr. K. Uchida on the distribution of cultivated land in Japan. The cultivated area of Japan proper is only about fifteen per cent of the country, but supports half the families. Ground suitable for rice supports the highest density, and therefore the tendency is to cultivate rice wherever possible.

A lecture by H.R.H. the Duke of Apulia described his experiences in the little known Tripolitanian Sahara. An address by Dr. W. Atwood, of Clark University, on the place and functions of a graduate school of geography, outlined conditions of work, staff, and equipment, that showed forcibly how far British geography and the appreciation of geographical work have to go in Great Britain before they can reach the level of attainment in the United States. After the congress a number of long-distance excursions took place to various parts of England and Wales.

Gas, Coal, and Tar Research.

NEW research laboratories of the Gas Light and Coke Co. at Fulham were opened on July 26 by Sir Richard Threlfall; the ceremony was preceded by a luncheon at the Company's head office at Westminster, and was followed by an exhibition of apparatus and methods, and by visits to the experimental plant.

Like many a common word in the more primitive languages, the term 'research' bears a number of different shades of meaning according to the varying circumstances of its use. In its use of the term the Gas Light and Coke Co. intends that it shall cover the most careful and strictly scientific examination, both on a small and on an impressively large scale, of every phase of the production, application, and possibilities of their products; further, that it shall include the laying of a sure foundation for the future conservation of our national coal supply. Generous as the company has been in the endowment of research, the new development is not philanthropic in its conception, except in so far as it indicates a sense of public responsibility. Since the company decided to expend considerable sums of money in re-housing part of its scientific staff, and providing them with the most modern forms of apparatus so as to facilitate their functions both of control and of original inquiry, it is to be presumed that it is convinced that this course is what is generally called a 'sound business proposition.' Not only does benefit accrue to the company itself, and thus to its 20,000 co-partner employees, and to every one of its 1,250,000 customers, but also valuable support is rendered to the State in its examination, on a national basis, of similar problems.

It may be said, perhaps with truth, that the prospect of cheap electricity is not without its influence on the progressive activities of the gas industry; if such is the case, it is well that the margin available for competition between the two forms of power should be explored without delay. Probably the gas industry has yet sufficient breathing space before cheap electrical power becomes a serious competitor. Another and perhaps more immediate problem, and one to which the Gas Light and Coke Co. proposes to give closer attention in its new laboratories, is that of low temperature carbonisation. Briefly, the position, which is not uncontroversial, is as follows. Gas companies normally distil coal at a high temperature, because by so doing they obtain a high yield of gas of satisfactory quality; the tar, the composition of which is now fairly well known, yields valuable pure compounds useful, for example, in the manufacture of dyes and drugs. Moreover, the coke can be used for making power gas or carburetted water-gas, or for domestic consumption in special kinds of stoves. Meanwhile we continue to use raw coal in millions of domestic hearths, polluting the atmosphere with foul smoke, and ignoring the fact that this objectionable material proclaims the loss of a potential source of wealth. If, however, the coal is distilled at a low temperature, a rich gas is obtained in smaller quantity, and the 'coke'—which still contains 10 per cent of volatile matter—forms a smokeless fuel which can be burned in ordinary grates. The tar fraction, however, differs markedly from ordinary tar, being much more complex, and as Prof. Morgan said in his paper on the subject at the recent Chemical Industry Conference, this material has been studied only since the War. Naturally, the new method of carbonisation has its own problems concerned, for example, with the type of retort, the caking of the fuel, and the suitability of the gas for ordinary use. Such, among others, are problems which the Gas Light and Coke Co. has undertaken to study.

The Luncheon.

Nearly two hundred guests were entertained by the Company to luncheon. The Governor, Sir David Milne-Watson, who presided, said that the gas industry was founded upon, and is carried on by means of, the process of high temperature carbonisation; whilst the new process of low temperature carbonisation needed careful investigation, the older process still presented many questions which invite scientific inquiry. One of the chief problems was that presented by the tar fraction. The research laboratories would be separate from works control, but would be in close touch with that control and with practice. The Mayor of Fulham, Alderman W. J. Waldron, welcomed the improvement which had been effected, saying that it was clear that the company was in close touch with the march of progress, and that the country had good reason to be proud of its work. The company recognised the double duty of service to the public and consideration for its employees. Fulham, he declared, would probably find itself in the future in the centre of the struggle for supremacy between electricity and gas.

Sir Richard Threlfall's Speech.

During the course of his speech, Sir Richard Threlfall said: "Inventions such as the use of fire were made before records were kept, but we have copious records of later inventions, and very likely the earlier ones came about in a fundamentally similar way, as assumed and put forward by Charles Lamb in his Dissertation upon Roast Pig. First comes the chance observation by an individual gifted enough to seek for its implications, then the attempt to reproduce the phenomena by copying the original apparatus, then the attempt to distinguish essential from unessential parts of the process leading to a working theory, and finally the improvement and simplification of the operation under guidance of the theory, which itself is subject to continual extension and improvement. . . . The early gas companies were kept busy for many a year in competing with each other, in extending their distribution system, in a perpetual struggle with municipal authorities and even with parliamentary committees, and had not any great margin of funds at their disposal; moreover, their technical personnel was not, in general, of the highly educated speculative inventive class. During the prosperous days of the nineteenth century the gas industry, like many others, did not devote much time or money to work for the future."

Sir Richard then proceeded to outline the circumstances involved in the birth and development of the Department of Scientific and Industrial Research, with which he has continuously been associated, and referred to the part it has played in finding properly equipped young men to carry on its investigations. "I have gradually come to the conclusion," he said, "that there is plenty of raw material among the young men and women of this country, which only needs reasonable encouragement to form the personnel of a large research army. In short, the parents of this country must be assured that science as a profession is worth following from the financial point of view before their sons and daughters will be allowed to embrace a scientific career." Attention was also directed to the qualities which a successful laboratory director must possess, and to

the contrast between the facilities which are nowadays enjoyed in the pursuit of science and those which were available fifty years ago.

THE LABORATORIES.

There are three principal laboratories, a conference room and library, and an office, together with a number of subsidiary laboratories—including an optical laboratory, a photographic dark room, and a thermostat room—as well as rooms containing service plant, and store rooms. The services comprise high- and low-pressure gas, coal gas (as distinct from the mixture of coal gas and carburetted water-gas), compressed air, vacuum, water, steam, and electric power at 220 and 2–15 volts d.c. A special workshop for making experimental apparatus will be included in the second half of the building, to be erected later. No. 1 laboratory (2700 sq. ft.) is to be used exclusively for general chemical research; ample space has been left for movable tables, and there is an adjacent balance-room. No. 2 laboratory, reserved for technical and semi-large scale work, is being kept as free as possible from fixtures. No. 3 laboratory will be used partly for research and partly for the chemical control of the operations carried out at the Fulham works. The products of low-temperature carbonisation tests at Richmond will also be examined at Fulham.

For the occasion of the visit there had been arranged a comprehensive display, with explanatory notes, of apparatus and methods which are employed in the research and control work. Although it is possible to mention only a few examples, it was everywhere evident that much intelligent thought and care had been devoted to the exhibition. In No. 1 laboratory were to be seen apparatus for micro-combustion and gas analysis, the determination of the vapour pressure of naphthalene, the thermal decomposition of methane and ethane, the sampling of gases, pyrometry, the analysis of coke and pitch, and the cracking of gas oil. In No. 2 laboratory were demonstrated the recovery of benzol from coal gas by activated carbon, the combustibility of coke, and refractory materials. No. 3 laboratory was devoted to a representation of the dehydration of gas and its influence on corrosion, the analysis and density of gas, and the tests appropriate to the analysis of gas oil, benzol, coal, coke, tar, ammonia, sulphur, and naphthalene. The basement contained various types of calorimeter, optical apparatus, and plant. The visitors were also conducted over the experimental gas-producing plant, where high-temperature horizontal retorts were in operation, together with condensers, purifiers, sampling apparatus, speedometers, calorimeters, etc., an experimental tar still, and a Salermo low-temperature retort.

University and Educational Intelligence.

LONDON.—Dr. Alexander Robertson has been appointed as from Sept. 1 to the University readership in chemistry tenable at East London College. From 1922 until 1924 he was Carnegie research scholar at the University of Glasgow, and was awarded a Ramsay Memorial Fellowship but resigned in order to accept a Rockefeller Inernational Science Fellowship for study at the Universities of Manchester and of Graz. Since 1926 he has been assistant lecturer in chemistry at the University of Manchester. He has published papers in the *Journal of the Chemical Society* on sabinol, pyrylium salts of anthocyanidin type, the synthesis of anthocyanins, and the syntheses of glucosides.

The title of professor of morbid anatomy in the University has been conferred on Dr. G. W. de P. Nicholson, in respect of the part-time post held by him at Guy's Hospital Medical School. The title of professor of bacteriology in the University has been conferred on Dr. Alexander Fleming in respect of the part-time post held by him at St. Mary's Hospital Medical School. In 1919 and 1923 Dr. Fleming was Hunterian professor, and in 1928 Arris and Gale lecturer of the Royal College of Surgeons; since 1920 he has also been lecturer in bacteriology in the Medical School of St. Mary's Hospital.

In view of Mr. S. A. Courtauld's munificent gifts for the Institute of Biochemistry and the Medical School of the Middlesex Hospital, the title of the University chair of biochemistry tenable there has been changed to "Courtauld Chair of Biochemistry in the University of London."

The following doctorates have been conferred: D.Sc. in chemistry on Mr. S. Guhasarkar (Imperial College—Royal College of Science), for a thesis entitled "The Influence of Groups and Associated Rings on the Stability of certain Hetrocyclic Ring Systems"; D.Sc. in geology on Mr. M. R. Sahni (Imperial College—Royal College of Science), for a thesis entitled "Studies in Jurassic and Cretaceous Terebratolids (Morphological, Evolutionary, and Zonal)"; D.Sc. in mathematics on Mr. Theodor Estermann (University College), for a thesis entitled "(1) On the Representations of a Number as the Sum of Three Products; (2) On Certain Punctions represented by Dirichlet Series; (3) On a Problem of Analytic Continuation"; D.Sc. (Engineering) on Mr. John Hollingworth (Imperial College—City and Guilds College), for a thesis entitled "The Propagation of Radio Waves"; D.Sc. (Engineering) on Mr. G. A. Hankins, for a thesis entitled "*A*. A study of the Methods used in Determining the Hardness of Metals. *B*. Experiments on the Behaviour of Metals under Alternating and Repeated Stresses," and other papers.

MANCHESTER.—The Council has accepted the resignation of Dr. Alex. Robertson, assistant lecturer in chemistry, on his appointment as reader in chemistry in the East London College, University of London; and also of Dr. P. W. Clutterbuck, demonstrator of chemical physiology, on his election to a Beit memorial fellowship for medical research.

Miss Eleanor M. Jackson has been appointed demonstrator in chemical physiology.

THE trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1928–29 to Mr. J. J. Green, of the Royal College of Science, London.

THE Aitchison Memorial Scholarship of the value of £36, open to all comers and tenable for two years in the full-time day course in technical optics at the Northampton Polytechnic Institute (London), is being offered. The examination will be held on Oct. 1 and 2. Full particulars can be obtained from the honorary secretary and treasurer, Mr. Henry Purser, 42 Gray's Inn Road, London, W.C.1.

THE ninth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, N.Y. It deals with institutes of legal medicine, and descriptions are given of the principal continental institutes, such as those of Paris, Berlin, Vienna, Cracow, Rome, and Lisbon. In striking contrast to the fine buildings and spacious accommodation commonly provided abroad for the subject, Great Britain is singularly deficient in this respect, and is represented in the series by the two relatively small departments provided at Edinburgh and Glasgow.

Calendar of Customs and Festivals.

August 5.

ST. JAMES' DAY (O.S.).—It has been suggested that the custom of resuming the eating of oysters on this day is to be connected with the use of their shell in the small erections of shells, pebbles, and flowers known as 'grottos' still to be seen on the pavements of London, for which gifts are asked by children with the request to 'remember the grotto.' These shrines have been attributed to the cult of St. James; but from the use of the shells and the importance of the oyster in British culture, as indicated by early references to British pearls, it might be inferred that the erection of the grotto marks an ancient propitiatory ceremony of a water deity upon whom such an important article in the early food supply as shell-fish was dependent.

August 6.

In Egypt, until recently, certain ceremonies were always observed at the cutting of the dams which released the waters of the Nile to flood the land. In Cairo this took place on some date between the sixth and the sixteenth day of August. These ceremonies marked the critical character of this period of the year for a country in which, in ancient as in modern times, the prosperity depended on an adequately high Nile. That this was recognised from the remotest times is indicated by the fact that these ceremonies were related to the heliacal rising of Sirius about the time when the river was at its lowest, and did not vary with the calendar, as did other religious feasts, which, owing to the inaccuracy of the Egyptian calendar even after the intercalation of five days in the solar year, completely traversed a year in the so-called Sothic cycle of 1460 years. The high antiquity of the cult of Osiris, the deity associated with the introduction of corn into Egypt, is evident from the fact that at the tomb of Osiris at Philae the number of cups filled daily with milk was 360, corresponding with the days of the year before intercalation.

It is evident that out of a fertility cult there grew a conception of the marriage of Isis and Osiris symbolic of the fertilisation of the land by the waters of the Nile. It is possible that at one time this conception had a more material representation in the sacrifice of a human being to the waters of the river. In the ceremony as it was performed in modern Cairo, a dam was constructed near the entrance of an ancient canal, which traversed the native quarter, just before the waters began to rise. On the outer side of this was erected a truncated cone of earth on the top of which a few grains of maize or millet were sown. This was known as the 'bride.' It was washed away by the rising waters a week or more before the dam was cut. This would support the tradition that it was once the custom to throw a maiden, gaily attired, into the waters to secure a plentiful flow of water.

In modern times money for which the people dive is thrown into the canal, and it is recorded by Seneca that at a place known as 'the Veins of the Nile,' near Philae, it was the custom for the priests to throw money and gold into the waters at a feast which took place at the rising of the waters. The 'wedding' of the Adriatic with a ring by the Doge of Venice and the Epiphany customs at the river-side in eastern Europe of the present day afford instructive parallels.

August 11.

ST. ATTRACTA, virgin and patroness of Killaraught, Co. Sligo. (Fifth or sixth century.) A saint whose acts (unauthenticated) afford sufficient ground for the conclusion that her legend enshrines a tradition of some pagan goddess. Especially noteworthy are her foundation of a 'house of hospitality' at the junction of seven roads; the vigour with which she cursed St. Connall when he refused to allow her to erect an oratory near his church, and her slaying of the monster of Lugna, a dragon which was devastating the country of King Bec, whose troops she afterwards saved when pursued while on a raid, conducting them in the manner of Moses through the divided waters of a river.

August 12.

ST. MOLAISE OF LAISREN, patron of Innismurray, Co. Sligo. (Sixth century.) Beyond the record in the 'Feilire' of Aengus, the list of Irish saints, and an annexed scholion that he was "the son of Declain of Inis Muiredaig in the north," nothing is known of this saint. His probably true character is that of an embodiment of a pagan cult. The island with which he is associated is celebrated in Irish legend and further contains a large number of remarkable antiquarian remains. These include a statue of the saint himself, which, significantly enough, is believed by the peasantry to be the work of Goban Saor, the traditional master craftsman of Ireland. In addition there is a stone fort or cashel of unmortared stone; the oratory of St. Molaise, a primitive structure with walls of remarkable thickness, a 'Church of the Men' and a 'Church of the Women,' surrounding the former being the Cemetery of the Men'—in which no woman could be buried, but if she were her body was removed by unknown hands—a 'Church of the Fire' of the fourteenth century, but thought to stand on the site of an earlier structure, a number of 'hole stones' and rude font-like stone objects known as *bullauns*, and two holy wells, that of St. Molaise being covered with a beehive-like structure of stones.

THE HARVEST.—Among primitive peoples, just as among the peasantry of civilised countries, the harvest is a time of sociability and rejoicing. Though the religious element may be present, it is sometimes unduly stressed by students primarily concerned with that particular aspect. An example among the American Indians of the south-west United States is the dance held in August, or so late as early September, by the Havasupai of Arizona, which in times of plenty is made the occasion of issuing invitations to the surrounding tribes of Hopi and Navajo, that they may share in the abundance and at the same time have an opportunity for trade. The feast may last for as much as three days and nights.

The dancing usually takes place towards evening as the day begins to cool, the earlier part being taken up with feasting, and on the third day with horse-racing, or in these days foot-racing, and trading. The children before the dance prepare a square, in the centre of which a pole is set up. As those who are to take part arrive they take up their station around the square, the women apart from the men. On the afternoon of the first day food is served out and an exhortation is addressed to the assembly by one of the chiefs. The dance, in which both women and men take part, circles around the chief, who stands in the centre facing the pole with a singer, usually, though not necessarily, a medicine man, who wears a coyote or fox skin pendent from his belt, has a broad band of brown paint across his eyes, and carries a drum. A peculiar feature of the dance is the function of a boy, disguised with a grotesque mask and grotesquely painted, whose duty it is to compel non-participants to join in the dance, beating the reluctant with switches. He appears just before or at midnight.

Societies and Academies.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 2, 1928).—B. A. Fedorovič: Multi-coloured sandstones of the Crimea. Pliocene deposits in Crimea are partly continental, partly marine in origin, and their fossil fauna presents evidence of considerable fluctuations in the climate of the Pliocene period.—A. Frank-Kamenetzky and N. Waksberg: Hydrochemical investigations of hot springs at Lake Baikal. Three hot springs studied belong to the category of thermal springs. In two of them the temperature of the water is 43-44° C., while in the third it is above 70°. The water is not strongly mineralised, but contains 15-30 per cent of silicic acid.—N. Olenev: Classification and geographical distribution of Ixodoidea. Notes on synonymy, morphology, and distribution of nine species of the genus *Hœmaphysalis*, including two new species. The distribution of *Hyalomma syriacum* is the same as that of its hosts, terrestrial tortoises of the genus *Testudo*. A doubtful species, *Ixodes arenicola* Eichwald 1830, is probably a synonym of *Hyalomma œgyptium* L.—N. M. Kulagin: A contribution to the biology of *Tylenchus scandens* Schn. The wheat nematodes have been found recently in many localities of Russia, always in galls, and never in grain, as recorded by other authors. More than five thousand young nematodes were reared from one gall. Dried nematodes survived at temperatures up to 88° C., but nematodes in water died at 50°.

Comptes rendus, No. 3.—P. Lazarev: The application of Le Chatelier's formula of viscosity to solutions of gelatine. Figures for the viscosity of gelatine obtained by Loeb ("Proteins and the Theory of Colloidal Behaviour." New York, 1922, p. 204) are in good agreement with those given by the Le Chatelier's formula.—P. Lazarev: The importance of the curve of visual adaptation in diagnosing nervous diseases. The interrelationship between normal and weak vision may be calculated by the aid of the formula $A_e/A = ES^2_1/E_1S^2$, where E and E_1 represent the perceptive ability of the nervous endings, S and S_1, the sharpness of vision in the normal and near eye respectively.—S. A. Jakovlev: The connexion of the basin of the Baltic Sea with that of the River Volga during the postglacial period. A study of the geological formations and of levelling data shows that the post-glacial basin corresponding to the Baltic Sea extended eastwards and included Lakes Beloozero, Peipus, Ladoga, Ilmen, and some others; further research may show whether the basin extended right to the Volga.—V. N. Zvetkov: Two new species of gregarines from Gammaridæ from Lake Baikal. Descriptions of *Gregarina acanthogammari* sp.n., from the stomach of *Acanthogammarus godlevskii* var. *victori* Dyb., and of *Gregarina baicalensis* sp.n., from the stomach of *Pallasea brandti* Dyb.—I. D. Kurbatov and L. I. Ignatova: The chemical composition of a yellow active mineral from Ferghana. A yellowish crystalline mineral from Ferghana exhibiting certain activities has been analysed quantitatively and proved to contain 9·74 per cent of V_2O_5 and 28·24 per cent of U_3O_8; its formula is $CaO(UO_3)_2.V_2O_5.+H_2O$.

VIENNA.

Academy of Sciences, May 3.—R. Weiss and W. Knapp: The action of phthalyl chloride on *m*-methoxy-benzoic acid and *m*-cresol-methyl-ether.—E. Späth and H. Bretschneider: The active components of Paracoto bark. Synthesis of proto-cotoin and of methyl-proto-cotoin.—F. Hecht and E. Körner: The thorium content of Katanga pitch-blende.—E. Körner and F. Hecht: Contributions to the method of chemical analysis of uranium pitch-blendes. Lead was separated electrolytically, thorium by means of sodium subphosphate, uranium by hydroxylamine and chlorhydrate in ammoniacal solution.—A. Smekal: The conductivity of solid silver iodide and copper iodide and the homogenation of mixtures of these two substances. The ions are regarded as sometimes taking part in the crystal lattice, sometimes free and migrating.—O. Sickenberg: A siren from the Leitha chalk of the Burgenland.—K. Singer and O. Deutschberger: Contributions to the physiological and pathological chemistry of the brain (2). The phosphatides and galactosides of the petrol ether fraction of the normal human brain. The distribution of these substances through the separate sections of the brain is very irregular. The galactoside content is less in the human than in the horse's brain. The nitrogen content of the brain declines rapidly in the fœtal but more gradually in the child's brain.—Karl Singer: (3) The phosphatides and galactosides of the petrol ether fraction of the brain in progressive paralysis and in cachexy. The nitrogen content expressed as a percentage of the dry weight was deduced; the nitrogen distribution in the petrol ether fraction showed a reduction of cholin nitrogen to about one third of normal and only traces of galactosid nitrogen.—F. Lieben and G. Ehrlich: The behaviour of aldol in the animal body and in fresh organ pulps. Aldol may be in great part consumed in the organism or built up to glycogen. In organ pulps, aldol is destroyed partly by way of β-oxy-butyric acid.—I. Mayr: The germination and early development of the mistletoe, *Loranthus europœus*.—K. Menger: Theory of convexity.—R. Wager: Prefloration formulæ.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 6, June).—Alvin B. Cardwell: The photo-electric and thermionic properties of iron. A narrow strip of electrolytic iron was suspended inside a nickel receiver, the whole being enclosed in a pyrex tube with a quartz window through which radiation from a quartz mercury arc could be admitted. Photo-electric sensitivity increased suddenly and decreased again as outgassing started; afterwards it rose in abrupt steps to a maximum. For outgassed specimens, the variation of sensitivity with temperature is complex, showing changes in the neighbourhoods of transition temperatures; the thermionic curve also shows a change near 910° C.—R. A. Millikan and G. Harvey Cameron: Evidence for the continuous creation of the common elements out of positive and negative electrons. (See NATURE, July 21, p. 111.)—William Duane: The general X-radiation from mercury vapour. Electrons are directed at right angles on to a stream of mercury vapour, and the radiation in the line of motion of the electrons and at right angles to this has been examined photographically and with an ionisation chamber. With a potential less than is required to excite the line spectrum, the ionisation effects show that neither beam is homogeneous, but both are of the same order of intensity per mercury atom. The experimental results for penetration of the radiation are in good accord with calculations based on the inverse square law for the distribution of energy in the spectrum.—A. W. Simon: On the quantity of electricity discharged in a lightning stroke. From the work of Norinder and of Peek, surface and volume charges are calculated. The potential gradient just before

the lightning flash is 6410 volts per cm., and the quantity of electricity discharged in a flash is of the order of 10 coulombs.—**Myrl N. Davis**: Secondary electrons from cobalt. A cobalt target was placed in the path of a primary beam of electrons, and the secondary electrons went to a cylinder immediately in front of the target. The ratio of secondary to primary current was plotted against accelerating potential for different periods of outgassing and heat treatment, and curves which are considered to be characteristic of cobalt were obtained. Cobalt gives much greater secondary emission than any other metal yet examined.—**Carl Barus**: Sparks of the induction coil between mucronate electrons. When one of a pair of needle points connected with the secondary of an induction coil is replaced by the tube of an interferometer U-gauge, it is found that there is a tendency to reach a definite electric wind pressure just before nearly linear sparks pass.—**Robert E. Burk** and **David C. Gillespie**: The adsorption kinetics for molecules attached at more than one point. If a molecule adsorbed on a surface is linked to more than one atom, desorption may not occur in one stage; doubly attached molecules would come off the surface at the same rate as singly attached molecules only in special circumstances. This may account for 'differential' heats of adsorption, in which it is found that the heat evolution varies during the process of adsorption.—**Robert N. Pease** and **Paul R. Chesebro**: Characteristics of homogeneous, exothermic gas reactions. Packing the reaction tube with clean fragments of pyrex glass has a marked inhibitory effect on the oxidation of hydrogen and iso-butane, and on the condensation of acetylene and ethylene. In these reactions, the accumulation of energy in molecules of the product seems to lead to miniature explosion waves (reaction centres), which, as they develop, produce a cumulative effect; the presence of packing limits development, the energy of the reaction centres being absorbed and distributed to the surroundings.—**John W. Gowen**: On the mechanism of chromosome behaviour in male and female *Drosophila*.—**Clyde E. Keeler, Evelyn Sutcliffe**, and **E. L. Chaffee**: Normal and 'rodless' retinæ of the house mouse with respect to the electromotive force generated through stimulation by light. Moist thread electrodes were used, one on the cornea and the other in the animal's mouth. Pigmented and albino mice with normal retinæ gave potentials very similar to those obtained with frogs, rabbits, human beings, etc., on stimulation with light. 'Rodless' animals (both pigmented and albino) gave no response. Hence, if electrical response is a necessary concomitant of vision, 'rodless' eyes are blind.—**G. Y. Rainich**: Radiation and relativity (1). An investigation from the special relativity point of view of a particle moving with the velocity of light, following the methods by which a material particle is studied.—**Willem J. Luyten**: On the absolute magnitudes of the Class *M* stars.—**Joel Stebbins** and **C. M. Huffer**: On the constancy of the light of red stars, with forty new variables of this class. 164 *M*-stars have been compared systematically with 165 *K*-stars as standards, using the photo-electric photometer attached to the 15-in. refractor at the Washburn Observatory. The *M*-stars show a tendency to variability with increasing redness, and also with increase of absolute magnitude. The very red stars may thus be termed the younger stars, with an irregular output of radiation; with time the variation probably keeps within definite limits. As these stars contract and grow hotter, they pass over to the steady *M*-state, and then on to the yellow class, *K*.—**Franz Boas**: Family traits as determined by heredity and environment. Observations of Central European immigrants to the United States show that head form and other traits are subject to environmental influences. A method is developed by which the non-hereditary elements may be distinguished from the hereditary elements.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Edinburgh, Session 1927–1928. Vol. 48, Part 2, No. 10: The Law of Blackening of the Photographic Plate at Low Densities. (Third Paper.) By Dr. E. A. Baker. Pp. 106-133. 1*s*. 6*d*. Vol. 48, Part 2, No. 11: Salmon (*Salmo salar*) of the River Moisie (Eastern Canada) 1926 and 1927. By P. R. C. Macfarlane. Pp. 134-139. 1*s*. Vol. 48, Part 2, No. 12: An Analysis of Preferential Voting. By D. M. Y. Somerville. Pp. 140-160. 2*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Royal Observatory, Greenwich. 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.) 7*s*. net.

Newport Public Libraries, Museum and Art Gallery. Fifty-eighth Annual Report and Balance Sheet for 1927–28. Pp. 14. (Newport, Mon.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 13, Technological Series No. 8: Research in Cotton Technology in India, 1927. By A. James Turner. Pp. iii+36. 1 rupee. Bulletin No. 14, Technological Series No. 9: The Effect of Different Spindle Speeds on the Results of Spinning Tests. By A. James Turner. Pp. ii+22. 1 rupee. (Bombay.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 25. Edited for the College by Dr. S. Graham Brade-Birks. Pp. 251. (Wye.) 8*s*. 6*d*.; Residents in Kent and Surrey, 4*s*. 6*d*.

Empire Marketing Board. May 1927 to May 1928. (E.M.B. 9.) Pp. 64. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1133 (Ae. 303): Full Scale and Model Measurements of the Lift and Drag of the Bristol Fighter with M.2 Section Wings. By E. T. Jones and A. S. Hartshorn. (T. 2554.) Pp. 8+8 plates. 6*d*. net. No. 1142: Report of the Symbols Committee. (T. 2521 and *A*.) Pp. 4. 3*d*. net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 379, July. Pp. 669-804+xxxii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 3, No. 3, July. Pp. 179-269. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

FOREIGN.

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