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Education for Environment.[1]

UNTIL a few years ago the various local governments in British Africa could justly have been accused of indifference to the educational needs of the native peoples committed to their care. Within the past few years, however, these same governments have given welcome evidence of their growing belief in education as the principal factor in the development of the capacities of the African peoples, and the need for supplementing the work of the various missionary bodies in the field of education. They have been given much encouragement in their efforts to improve native education by the Advisory Committee on Education in the Colonies, which from its inception has had at its command the services of Major Hanns Vischer, who combines a genuine enthusiasm for education with an almost unique knowledge of the peoples of Africa and a sympathetic understanding of their needs. Equally important has been the stimulus given to educationists in Africa by Mr. Ormsby-Gore, Mr. Jesse Jones and his associates, and the members of the Hilton-Young Commission, all of whom have visited Africa within the past six years.

In addition to the encouragement and stimulus from without, local governments find they are being urged from within to increase the educational facilities for the natives. The natives themselves are almost clamorous in their demands for education, particularly 'education by the book', just as in India, since the capacity to read and write in the language of the dominant whites gives those who possess it a comfortable feeling of superiority over those who do not, especially as it carries with it the possibility of clerical or other semi-professional work for government or for the trading community, and this work is the best paid.

In striking contrast to the thirst for instruction exhibited by the Africans is the comparative indifference of the adult members of the white-settled communities in tropical and sub-tropical Africa to the educational needs of white children. In Kenya, Tanganyika, Nyasaland, Northern Rhodesia and Southern Rhodesia, there are many white children who are receiving practically no formal instruction at all, with the inevitable result that in each of these territories there is growing up a class of illiterate whites. If this state of affairs is not soon ended, each of these territories will have its own 'poor white' problem, a problem which is already intense in the Union of South Africa and

[1] Southern Rhodesia. Report of the Education Commission. Pp. ii+187. (Cape Town: *Cape Times*, Ltd., 1929.)

is causing much anxiety to the Union Government, for the 'poor white' is an unemployable; too ignorant and incompetent to be worth employing in a skilled capacity, but cursed with a superiority complex which prevents him from seeking employment in occupations regarded as only fit for blacks.

Even those white parents in these territories who do send their children to the schools provided by the Government or voluntary bodies are almost without exception uncritical of the instruction given. They are apparently pathetically content that such instruction should be almost identical in form and substance with that which is provided in the schools in Great Britain. The majority of these white children will probably never leave Africa, essentially an agricultural continent, only a very few will proceed to a university, but their school studies are almost exclusively literary, more so than in the average grammar school in Great Britain, divorced from the realities of their environment and more likely to engender distaste for African life than to inculcate an intelligent appreciation of the significance of Africa in world economics and politics or a sympathetic understanding of its peoples, without both of which the assumption of leadership by the white minorities in Africa is an impertinent presumption.

World opinion now demands that the whites in Africa should equip themselves for leadership. An essential part of this equipment is the capacity to adapt themselves to the changed order of things. The exploitation of the Africans by the immigrant races is no longer condoned by most of the governments in Africa. The prosperity of the whites has to be based on something other than the misery of the blacks. It can be attained by the development of the other natural resources of the continent. The development of these resources, animal, vegetable, and mineral, is obviously dependent upon the quality of the co-operation between the Africans and the whites, and this in turn is determined by the "right adjustment between the developing human organism and its surroundings" (Sir Richard Gregory's definition of education), whether the human organism be white or black.

The school, it is true, is only one of the many forces at work to secure this adjustment; but it can be made the most potent of them all, if it provides "an education that works and moves entirely amid the facts and circumstances which make up the texture of life for its pupils", the aim set forth in the recent published report of the Education Commission, which was appointed at the beginning of 1929 by the Governor of Southern Rhodesia, Sir Cecil Rodwell, to inquire into the present system of education, other than native education, of that colony.

This Commission surveys with admirable clarity and understanding the facts and circumstances of the life of the white-settled community in Southern Rhodesia. The white colonists, mainly of British stock, comprise less than 5 per cent of the total population, but they are the dominant political power. The natives are docile and intelligent. The Asiatic element in the population is very small as compared with that in the Union of South Africa or Kenya, and there is no Arab slave tradition as in eastern Africa. It is a country of known great natural resources, both agricultural and mineral, and still greater possibilities. It enjoys a fine climate. It is situated in the midst of other great productive areas and is across the main lines of communication of the southern part of Africa. Its political, economic, and social development is bound to exert a powerful influence on such development in other African colonies. Also, since the determining factor in this development will be the white minority, it is all-important that this white minority should be provided with an education which will fit it for its great responsibilities. "In a community of white people set amidst a great black population", says the Commission, "the obligation to give every white child the most complete education which he is capable of receiving must be accepted at whatever cost."

The Commission considers that the main permanent objectives which a system of education for the white community in Southern Rhodesia must have in view are:

1. "The continuance in full strength of the European inheritance."

2. The erection and maintenance of "a community that will be, in every aspect of its life, characteristically Rhodesian".

3. The development in the youth of the country of "the moral stamina to overcome the strong and subtle influences which, in a mixed society like that of Rhodesia, are constantly at work to sap the energies and weaken the moral tenacity of the privileged European".

4. "The development and wise use of the great natural resources of the country."

For the attainment of the first objective the Commission regards it as essential that not only teachers, but also other educating agencies, must continue to come from Europe, particularly from Great Britain, for this will ensure that the common store of achievement in literature and art and the

general apparatus of civilised life will be drawn directly from the source, to provide for those born in a hitherto barbarous land such as Southern Rhodesia " the best substitute for that rich background of long-established civilisation which is the unconscious inheritance of every child in an older community ". As regards the second objective, the Commission lays emphasis on the educative value of the study of " the natural life of Rhodesia, its plants, animals, insects, climatic phenomena and so forth ; the life of the natives which so intimately and subtly concerns the welfare of every child ; the main industries ; the history of African settlement ".

Regarding the third objective the Commission refers to " the danger of moral degeneration which threatens the youth of a country, where the services of others are so easily come by, and where the labour that serves the first needs of life is apt to be despised as menial and dishonouring ". It recommends strongly that the expert aid of psychologists should be enlisted to investigate the influences on the life of white children through their many contacts with the native peoples, particularly in connexion with the attitude of the former to the latter. The fourth objective will be best attained, it believes, by the multiplication of centres to provide facilities for training skilled workers, and better and more systematic co-operation between the schools on one hand and organised industry and the technical departments of Government on the other.

There follows a critical survey of the existing facilities for the education of the whites in Southern Rhodesia. Various recommendations are made for the improvement of the system. Southern Rhodesia is warned of the dangers of parochialism in education, and in particular is advised to lose no opportunity for friendly and fruitful co-operation with the Union of South Africa. Equally important are the suggestions made for the co-operation of parents with school authorities. The tendency on the part of parents to regard teachers as a class apart, and schools as institutions with no links with the homes of the scholars, is not uniquely a Southern Rhodesian phenomenon : it is almost universal. In this connexion the Commission's suggestion, that one means of promoting co-operation between parents and the education authorities would be by designing better home-tasks for pupils, merits the most careful consideration in Great Britain.

This is by no means the only need Southern Rhodesia and Great Britain have in common. Where secondary schools exist in any British colonies, they appear to be based on home models, that is to say, the school curricula are designed to meet the needs of the universities to which only a very small proportion of secondary school scholars will proceed. Parents and the public generally condone this, the former because they lack the courage to resist the demand by employing bodies for the stereotyped educational hall-marks prescribed by universities. The needed change will only be brought about, as the Commission states, by the public realising that " Secondary schools should be regarded as the final stage of school education for the many rather than as the preparatory stage for the few ". The need in all countries of the Empire is for the provision of a variety of secondary courses of equal status, not " one selected body of studies having a traditional pre-eminence over others, any more than it can be regarded as the exclusive privilege of a select class ". In any course, however, the Commission strongly recommends the inclusion of manual training and general science subjects, including biology. What is surprising is the reaction of the Commission to the suggestion made by certain witnesses that some provision should be made in the white schools for the study of native languages. The Commission says quite definitely that " the advantage to be gained from the introduction of native languages as a school study is not sufficiently great to justify the encroachment that would be involved on the time available for other studies ".

A chapter of the report is devoted to agricultural education. " Comparatively little has been done in Rhodesian schools to develop interest in the problems and the life of the countryside, and to produce what may be called rural-mindedness." This the Commission attributes mainly to the fact that " primary education in the Colony has been dominated by secondary education, and the secondary schools have been developed under teachers whose own education and training have been in the main on purely academic lines ". But Rhodesian parents also object to their children " digging and hoeing ", or doing any other form of manual work, since such occupations are regarded as ' Kaffir ' work, too degrading for whites. The result in Rhodesia as elsewhere is the progressive migration of the rural population to the towns.

The staffing of the white schools in Rhodesia is adequate to the extent of generosity, but there is an undue proportion of untrained teachers, particularly in the secondary schools. This the Commission regards as a grave defect. It considers that both a university degree and training are essential for secondary school work, and backs its opinion

by the specific statement that the proportion of untrained teachers among the inefficient teachers is very much higher than the proportion of untrained teachers in the service as a whole. This opinion is valuable, for it gives added authority to those members of the Colonial Office Advisory Committee on Education who have, for some years past, advocated the provision of professional courses, prior to appointment, for those graduates from British universities who wish to enter the education services in the Colonies. A. G. CHURCH.

The Philosophy of Spinoza and Leibniz.

The Philosophy of Spinoza: The Unity of his Thought. By Richard McKeon. Pp. ix+345. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1928.) 25*s.* net.

Spinoza. By Prof. Leon Roth. (Leaders of Philosophy Series.) Pp. xvi+250. (London: Ernest Benn, Ltd., 1929.) 12*s.* 6*d.* net.

Leibniz. By Prof. Herbert Wildon Carr. (Leaders of Philosophy Series.) Pp. vi+222. (London: Ernest Benn, Ltd., 1929.) 12*s.* 6*d.* net.

THE new series of publications which, under the title of "Leaders of Philosophy", is being edited by Prof. J. L. Stocks, ought to supply a want which has long been felt. It is true that certain of the volumes contained in Blackwood's "Philosophical Classics", such as Adamson's monograph on "Fichte" and Croom Robertson's on "Hobbes", are in their way unique and of permanent value; but they were written nearly fifty years ago, and the last half-century has been particularly fruitful in historical and critical work respecting all the philosophical systems that have influenced western thought. There is, therefore, ample room for such a set of volumes as Prof. Stocks contemplates; and with those that deal with Spinoza and Leibniz, the two greatest metaphysical thinkers of the pre-Kantian period, the new series appropriately makes a start.

At first sight, it is true, the individualism of Leibniz would appear to be diametrically antithetical to the universalism of Spinoza. But, as Prof. Roth points out, when it comes to a detailed working out of the two systems, the opposition tones down, and the similarities are at least as striking as the contrasts. Prof. Roth instances Leibniz's theories of soul, of pre-established harmony, of liberty, of perfection, as depending on specific features in Spinoza's doctrine; and he refers to the cardinal notion of activity (*esse* = *agere*) as being already involved in Spinoza's view of modal being. He might, however, have gone further, and have shown that in the end both thinkers were confronted with precisely the same crucial issues.

Prof. Carr's account of the historical background of Leibniz's career, as also of the intellectual world of the last half of the seventeenth century, is extraordinarily well done, and forms a most fitting introduction to the later study. In setting forth the various aspects of Leibniz's philosophy, there is room for considerable difference of emphasis, if not of interpretation. For, although the philosophy is in itself essentially systematic, yet Leibniz himself left no single systematic exposition of it, and a connected view can only be obtained by drawing together what was put forward in detached letters and papers and essays. Prof. Carr justly lays stress upon the characteristics of unity and activity as defining for Leibniz the notion of real existence. In contradistinction from the discreteness of a physical atom, consisting of *partes extra partes*, the unity of a real existent was the unity of an internal variety; and, in contradistinction from 'moving force', its activity was an 'implanted principle of change and persistence', involving effort, *conatus*, and that without external stimulus. In other words, a real existent, or monad, was essentially psychical in character.

It was, however, by the help of a further consideration that Leibniz was enabled to advance from this fundamental conception to the thought of an infinite plurality of monads—the consideration, namely, that psychical activity cannot be a mere flowing forth of unimpeded energy, because this would give no more manifestation of itself than would an elastic force which met with no resistance. Accordingly, a monad must be both active and passive: active, in order to exist at all; passive, in order to exist as an individual and to manifest itself as a centre of activity. Hence the existence of one monad presupposed that of a world of monads with which it was in some way in relation, otherwise its unity would be impossible. I think it is because Prof. Carr makes no reference to the passive side of the monad's nature that Leibniz's philosophy, as he presents it, appears to be even more lacking in coherence than it really is. For it was just this element of passivity, of limitation, of finitude, that Leibniz fixed upon to explain the appearance, in the life of the more developed monads, of the phenomenal world of sense-experience. In so far as the monad is passive, its representations are, he argued, obscure and confused, and what is obscure and confused *seems*

to it foreign, other than itself; *seems*, that is to say, to be external and material. In brief, it was owing to the element of passivity in the constitution of the human mind that what is in truth non-spatial appears to us as extended. All this important side of Leibniz's teaching Prof. Carr leaves untouched.

The volume by Prof. Roth is an able and scholarly piece of work, admirably adapted for those who are beginning the study of Spinoza. It is divided into three parts, dealing respectively with Spinoza's life and general outlook, his philosophy, and his place in the history of thought. Emphasising the fact that it was primarily as a moralist, bent on ascertaining the true goal of human endeavour, that Spinoza embarked upon metaphysical inquiry, Prof. Roth unfolds with singular lucidity and well-balanced judgment the main results of the quest. Nothing could be better in their way than the chapters that expound Spinoza's view of human beings as parts of Nature and the three grades which he distinguished of knowledge and conduct. Where I think the author has been less successful is in his treatment of the metaphysical foundation of the whole system. For bringing out the real significance of the metaphysic, it seems to me to be necessary to take account of the logical method that was being pursued; and, in particular, to be clear that it was with the notion of reason and consequent, and not with that of cause and effect as ordinarily understood, that Spinoza was proceeding. Moreover, it is unfortunate, so far as his exposition is concerned, that Prof. Roth seems unable to make up his mind as to whether what he calls "a recent gloss", which identifies what Spinoza described as 'extension' with physical energy, is justifiable or no, because the interpretation of the metaphysic depends to a large extent on which of these views is taken.

Dr. McKeon's book is planned on a more ambitious scale than Prof. Roth's, and makes greater demands on the reader. It is evidently the work of one who has laboured long and meditated much upon the philosophy which it seeks to exhibit as a unified whole. The chapter, for example, on Spinoza's attitude towards experimental science is, in itself, a valuable contribution to Spinoza literature, and the account it contains of the controversy with Boyle ought to remove several prevalent misapprehensions. So, too, in treating of Spinoza's doctrine of the passions, and of the function of the intellect in respect to the passions, the author has conscientiously striven to bring out the essential things and to play the part of a faithful expositor. Again, however, the least satisfactory portion of the work is that which handles the metaphysic. It is true Dr. McKeon gives due prominence to the conception, fundamental for Spinoza, that while each finite thing is conditioned to exist and to act by another finite thing, which is its cause, and this again by another, and so on *ad infinitum*, yet all these finite 'modes' depend upon an ultimate ground in such a way that without it they can neither be nor be conceived. Unhappily, however, in this context a serious printer's error has been left uncorrected on p. 192, which altogether obscures the sense of the important quotation from "Ethics", i. 17. But there is no adequate discussion of the notion of Substance, or of the relation of the 'modes' to Substance.

In point of fact, it is impossible to make clear the metaphysic of either Spinoza or of Leibniz except by a critical treatment; mere exposition is not enough. For the truth is that in the writings of both of them two inconsistent conceptions of infinite or ultimate being are struggling for expression; and the exigencies of their thinking occasion repeated oscillation between these two conceptions. Spinoza, working on one hand with the principle *omnis determinatio est negatio*, conceived of Substance as purely indeterminate being, being in respect to which any positive characteristic would infringe its absoluteness; and then Substance was for him simply the unconditioned, that which must be in each particular 'mode', but in which the particular 'mode', *as particular*, could not be contained. On the other hand, working with the principle that each finite 'mode' expresses the infinite in a definite and determinate manner, he conceived of Substance as *ens realissimum*, the sum of positive reality, and it is this conception which Dr. McKeon and Prof. Roth ascribe to him. But the two conceptions are obviously incompatible; and, whichever alternative be selected, it is clear that the particularity of finite 'modes' is left without a ground.

Similarly in the case of Leibniz. On one hand, in accordance with the principle of continuity and with the notion of a graduated scale of existents, God was for him, as Prof. Carr explains, the 'supreme Monad', the culminating term in the series of monads, although manifestly the difference between the 'supreme Monad' and any finite monad can no longer be a difference of degree only, as that between the other members of the series had been declared to be. On the other hand, however, if each monad is essentially an individual,

and if individuality is dependent on the passive, limiting element, it is evident that God, as *actus purus*, as wholly devoid of passivity, cannot be a member of the series of monads, in the sense in which the term 'monad' had been originally defined. For God then becomes what Leibniz himself once said a monad without passivity would be, "a deserter from the general order". Accordingly, we get the theory of a transcendent supramundane deity, who calls the world of monads into existence by an act of will, although what it is that converts the ideas of them in the mind of the deity into actual existents remains, from the necessity of the case, an inexplicable mystery. And, indeed, as though conscious of this perplexity, Leibniz is not seldom to be found hinting at yet another view, according to which God is the source of all monads, that proceed from him by "a sort of emanation as we produce our thoughts"; and then, while it is true the word is retained, the doctrine of monads would appear to have vanished, and that of *deus sive natura* to have taken its place.

In fine, it has to be said that while Leibniz's philosophy undoubtedly contains features which are in advance of anything contained in the "Ethics", features that make for a more concrete conception of the world of existing realities, it proceeds largely by the help of like abstractions, and terminates in difficulties similar in kind to those which beset the path of Spinoza.

G. DAWES HICKS.

Geometry of *N* Dimensions.

An Introduction to the Geometry of N *Dimensions.* By Prof. D. M. Y. Sommerville. Pp. xvii + 196. (London: Methuen and Co., Ltd., 1929.) 10*s.* net.

IT needs courage to produce a text-book on the geometry of *N* dimensions. The subject is not unduly difficult to those who take an interest in it, but most people have deeply seated prejudices which prevent them from taking it seriously into consideration. One of the pioneers, Schläfli, in spite of his reputation in other branches of mathematics, failed to secure publication for his valuable memoir on hyperspace, and in fact it did not appear in full until after the author's death and fifty years after it was written.

Let us examine the prejudices that are responsible for such obstruction, and consider how far they are justifiable. The crudest form of prejudice is what may be called the 'common-sense' opinion that as space cannot have more than three dimensions, any consideration of hyperspace is obviously nonsense. This opinion is due to a misapprehension as to the nature of the science of geometry, which certainly started as a form of surveying or 'earth-measuring', but even in the time of the ancient Greeks had developed into a semi-abstract science, to be deduced from a limited number of definitions and axioms. We use the word semi-abstract rather than abstract, because in the time of Euclid, and for more than two thousand years after him, it was supposed that the axioms were self-evident truths about the real world. Only one axiom, that concerning parallels, appeared to fall short of the high standard of the others. No one doubted its truth, but it was scarcely self-evident. Many attempts were made to prove it, but all failed, and at last it was realised that a logical system of geometry (non-Euclidean) could be constructed by starting with the denial of the parallel axiom. This was the starting-point for further progress, and by slow degrees it was recognised that there are an unlimited number of different kinds of geometry, each based on a certain set of axioms, which were really more or less arbitrary assumptions. Moreover, the terms used in these geometries, such as straight line and plane, are not really fully defined; all that we know about them is that they are assumed to have the properties stated in the axioms.

Geometry, then, is a sort of mental game played with an arbitrary set of rules, and by varying the rules we can get different kinds of geometries. By varying only the parallel axiom we get non-Euclidean geometry of three dimensions; by varying only another axiom we get Euclidean geometry of four or more dimensions, with which Prof. Sommerville's book is concerned. Of course we could also vary two or more axioms at once, giving for example non-Euclidean geometry of four dimensions.

Even when all this is recognised, it is still felt by many that hypergeometry, in spite of its logical self-consistency, is rather an unprofitable subject of discussion, like the medieval schoolmen's topic of how many angels could stand on the point of a pin, which, it should be remembered, had to be argued in strict conformity with the rules of logic from certain assumed premises. Many scientific workers cannot escape from the opinion that hypergeometry can have no application to the geometry of the real world and cannot possibly have any application to physics or other branches of science. Well, they are wrong. Hypergeometry can be employed to discuss the properties of a cubic surface in three

dimensions, just as three-dimensional geometry can be employed to discuss the properties of a quartic curve in two dimensions. The bitangents of such a curve, as Geiser showed, can with advantage be considered as the projections of lines on a cubic surface. Segre and other Italian mathematicians showed how, in an analogous way, a cubic surface can be considered as the projection of a four-dimensional configuration.

These researches have been brought within reach of English readers by Prof. Baker's "Principles of Geometry", vol. 4, in which he gives illustrations of the utility in geometry of the consideration of space of higher dimensions, especially of four and five dimensions. As for physics, the importance in relativity of one particular kind of non-Euclidean geometry (Riemannian) is now widely recognised. Beginners in wave mechanics naturally assume that the three dimensions required in Schrödinger's theory of the motion of a single particle are the three dimensions of ordinary space, but as soon as we come to the case of two particles six dimensions are required. Possibly this fact is not generally recognised. As Eddington remarks, "Schrödinger's theory is now enjoying the full tide of popularity, partly because of intrinsic merit, but also, I suspect, partly because it is the only one of the three that is simple enough to be misunderstood". Many problems in thermodynamics require a number of dimensions (or degrees of freedom) exceeding three. Coming to other sciences, R. A. Fisher's "Statistical Methods for Research Workers", a book addressed to biologists and others, is partly based on a use of the geometry of hyperspace. The vagueness in the undefined terms of abstract geometry, which at first appears such a defect, is in fact an advantage, for it enables the science to be applied to entities which are very different from those considered in 'earth-measuring'.

After so lengthy a justification of the study of hypergeometry, the discussion of the details of Prof. Sommerville's treatment must be very brief. Of the three main branches of hypergeometry, metrical, projective, and differential, he deals fairly fully with the first and less fully with the second, possibly in view of Baker's treatment mentioned above. The third aspect is not dealt with here, presumably because of the full treatment that it has received in connexion with relativity.

Prof. Sommerville's first four chapters explain the fundamental ideas of incidence, parallelism, perpendicularity, and angles between linear spaces. Then follow two chapters on analytical geometry, projective and metrical. The remaining four chapters, perhaps the most attractive part of the book, deal with regular figures in hyperspace, corresponding to the ordinary regular solids. As a parting word to those who are still afraid that the subject is too abstract, we may mention that there are sixty diagrams and several references to sets of models.

H. T. H. PIAGGIO.

Scientific Prospecting.

Applied Geophysics in the Search for Minerals. By Prof. A. S. Eve and Prof. D. A. Keys. Pp. x + 253. (Cambridge: At the University Press, 1929.) 12*s.* 6*d.* net.

THE location of mineral deposits and structures associated with the formation of minerals by their deformation of natural and artificial fields of physical force is a comparatively recent branch of geophysics, having its origin mainly in the economic requirements created by the War, and owing much of its development to the methods evolved during the War for the detection of unseen bodies. The literature describing the various methods and apparatus used consists mainly of scattered papers in technical journals. Notable attempts to co-ordinate this mass of material have been made by Ambronn, in his book on applied geophysics, translated from the original German by Dr. M. C. Cobb ("Elements of Geophysics"; see NATURE, July 13, 1929, p. 52), and by the American Society of Mining and Metallurgical Engineers in the symposium "Geophysical Prospecting, 1929". The former work outlines the early history of applied geophysics and is a mine of information on related literature, but is written rather for the specialist than the general reader. The latter work is a collection of essentially specialist papers on details of procedure and practical work.

In the present work, Profs. Eve and Keys have attempted to produce a concise and reasonably detailed text-book on applied geophysics, suitable for physicists, geologists, and mining engineers—in short, for all who may in their practical work require a fairly complete knowledge of this subject. It may be said that they have most decidedly succeeded in their difficult task. They have carefully steered between the dubious imaginativeness of the 'popular' account, and the bleak inhospitality of the 'specialist' exposition, and have produced a sound, well-balanced treatise. The engineer or geologist who is not thoroughly familiar with physical principles can yet derive a good working knowledge of these geophysical methods, and obtain a well-reasoned assessment of the relative applicability

of each method to a particular problem. On the other hand, no difficulties are shirked, so that the physicist can obtain a correct insight into the basic principles underlying each method, and a satisfactory treatment of the methods and apparatus employed. Where he wishes for further enlightenment, he is referred to extant papers written by specialists. In this latter respect, however, the bibliographical references are not quite so extensive as could be wished, but further references appear at the end of the book.

The first fifteen pages of the volume are devoted to an introduction containing a sketch of the history and principles of geophysical methods as applied to the location of minerals, and reveal the essentially practical outlook of the authors. In Chap. ii. (pp. 16-52) magnetic methods are discussed, and a very lucid account presented of the principles and apparatus employed. Chap. iii. (pp. 53-111) is concerned with electrical methods, and more particularly with earth-resistivity measurements, to which the authors have given especial prominence based on their own field tests. Their treatment of the potential methods is rather scanty, and would bear amplification in view of the amount of material available. On the other hand, in Chap. iv., which deals with electromagnetic methods wherein the variations in the electromagnetic field are measured by means of search-coils, the authors have within the scope of 37 pages presented by far the best review of these methods that has yet appeared. The vital problem of the elliptic polarisation of the field due to phase differences between the constituent electromagnetic vectors is boldly dealt with. Chap. v. (pp. 149-182) details the gravitational method, and, whilst thoroughly sound, would be improved by a few examples of the theoretical effects due to various simple types of structure and more details of quantitative interpretation made possible by consideration of such types. Also the possibilities of isogam representation are rather scantily dismissed. Seismic methods are discussed in the twenty-seven pages of Chap. vi., which is somewhat scurvy treatment for a method which has had such success in locating salt-domes and other structures. Lastly, Chap. vii. devotes thirty pages to radioactive, geothermal, and other methods which have, as yet, attained little practical value. A bibliography and index complete the volume.

The only real criticism possible is that the sections dealing with other methods might usefully have been expanded to the same degree as the ones devoted to electrical processes. At the same time, the authors are to be heartily congratulated on the extraordinarily concise and attractive presentations of these methods which they have given. The book should be invaluable to all interested in applied geophysics, including the specialist, who will turn to it repeatedly, especially when he wishes to readjust his horizon to 'practical politics'. The price is very reasonable indeed for such a pioneer work, and the typography and illustrations are excellent. This is not a book to lie at rest on the library shelf, but one to be read with enjoyment and then treated as a constant source of reference on all questions on this fascinating subject, which may truly be styled 'the new treasure-hunting'.

Our Bookshelf.

Principles of Experimental Psychology. By Prof. Henri Piéron. Translated by Prof. J. B. Miner. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 190. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 10*s.* 6*d.* net.

PROF. PIÉRON is known to psychologists in Great Britain as carrying on the work of Binet at the laboratory of the Sorbonne, and as the author of numerous monographs, as well as a treatise on thought and the brain, already translated into English. In the work now translated, and added to the Library of Psychology and Philosophy, he defines psychology as "a science of behaviour, of activity, of the co-ordinated responses of organisms, considered in their totality". He thus holds a form of behaviourism, but his position is by no means identical with that of J. B. Watson.

With his modified form of behaviourism as his guiding principle, Prof. Piéron summarises the work of psychological science as he understands it, and the reader naturally finds that his exposition wears a very different aspect from that of the more orthodox treatise. He first discusses reaction processes, affective, perceptive, and intellectual, and then gives valuable sections on levels of activity, and mental stages and types. Very good examples of careful statement, based not on mere speculation but on scientific inquiry, are seen in what he has to say about masculine and feminine types, and about that much used but imperfectly understood term 'intelligence'. Every page of the book shows, however, that it was well worth translating. Only a master could have said so much in so few pages, and said it with such perfect clarity.

The New Nature Study. By F. J. Wright. Pp. 287 + 4 plates. (London: Thornton Butterworth, Ltd., 1929.) 5*s.* net.

THE term 'Nature study', as used by modern educationists, is not a synonym for natural history, or for what is vaguely called the study of Nature. The primary concern of Nature study is not with the acquisition of knowledge, but rather with the cultivation of the scientific habit of mind by the logical correlation of natural phenomena. The

selection of material suitable for investigation of this kind by young pupils is the teacher's main difficulty, but in practice it has been found that the behaviour of familiar animals and plants lends itself most readily to the method desired.

For this reason it is, unfortunately, often supposed that Nature study is a dilute form of natural history, and Mr. Wright's attractive book gives some countenance to the idea. He frankly refers to the study as a 'hobby', the aim of which is to acquire knowledge. The method of study he advocates is 'new' only in being based upon phenological recording. It is well that attention should be directed to the great importance of the observational work organised by the Phenological Committee of the Royal Meteorological Society; and not the least valuable part of the book is to be found in the appendices on "A History of Phenology" and "Phenology Abroad", which are respectively contributed by Mr. J. Edmund Clark and Mr. I. D. Margary. To phenological observers the book may be recommended as a gossipy, though sententious, guide to the identification of the plants and animals specified by the committee. It is to be regretted that the manuscript was not revised by a competent botanist, who would have eliminated references to the petals of the wood-anemone and to turnip bulbs, with various other unfortunate slips. The volume contains a number of useful diagrams and five photographic illustrations.

Enigmas: Another Book of Unexplained Facts. By Lieut.-Comdr. Rupert T. Gould. Pp. 320 + 8 plates. (London: Philip Allan and Co., Ltd., 1929.) 12*s.* 6*d.* net.

THOSE who have read Commander Gould's "Oddities" will be equally interested in his new book, which consists of a series of essays the object of which is to collect and digest the facts relating to a number of incidents which have not, up to the present, been satisfactorily explained. He opens by discussing legendary giants, and sums up against the existence of any race of giants, although admitting that men of unusual tallness have been seen among the Patagonians. The "Cry of Memnon", a sound emitted at or near sunrise by an Egyptian statue at intervals during a period of two hundred years is ascribed to unequal expansion of two portions of the stones forming the statue.

Legendary longevity is another interesting topic, and it seems well established that Old Parr did really attain a remarkable age. In discussing the controversies surrounding the first land sighted by Columbus in the Bahamas, and the various mythical discoveries of a north-west passage from the Atlantic to the Pacific, the author is in his element, and is able to bring all his nautical experience to bear on the problem. However, the detail is at times wearisome. The mysterious ringing of bells is described but left unexplained. The book closes with a discussion of the objective reality of the so-called canals on Mars, from which it appears that the case for their artificial origin is 'not proven'. L. J. C.

Outlines of Zoology. By Prof. J. Arthur Thomson. Eighth edition, revised. Pp. xxviii + 972. (London: Oxford University Press, 1929.) 21*s.* net.

EVERY teacher of zoology thinks that, if only he had time, he would write the ideal text-book for his students; and not a few have found the time. The trouble usually is that so small a public outside the particular school concerned considers the work acceptable. But in this most uncertain market Thomson's "Outlines of Zoology", written primarily for students in the Scottish universities, apparently meets some very real demand, for it goes steadily on to its eighth edition and undiminished popularity throughout the country.

This book will never completely satisfy the student of comparative anatomy; but such is not its aim. The author expressly intends it to be used as an accompaniment to other well-known works. As such it should be an invaluable member of the small library that even the most impecunious must possess, for in it he may learn to see the organism as a whole and living, and, as he reads, he will find guidance to certain vital aspects of his subject that many of the famous text-books of zoology ignore.

The present edition is some hundred pages longer than that published in 1921. To meet the needs of the more modern teaching, the author has expanded especially the chapters on function and development, the section on genetics has been increased, and one hundred additional illustrations have been inserted. D. L. M.

Chemistry in the Home. By Dr. J. B. Firth. Pp. 246. (London: Constable and Co., Ltd., 1929.) 5*s.* net.

THIS book, which is intended especially for housewives, welfare workers, and women teachers, is divided into two sections, the first dealing with the atmosphere, ventilation, water supply, heating, lighting, cleansing materials, disinfectants, and textile fibres, whilst the second is devoted to foodstuffs and beverages. The subject matter is of very general interest, but the treatment is inadequate, the style of the writing being rather careless and unattractive. Moreover, the title of the book seems badly chosen, since no attempt is made to develop the chemistry of the subject, chemical formulæ and equations being carefully avoided for the sake of "those who have no previous knowledge of chemistry".

The volume contains a highly condensed mass of facts, which are often merely enumerated without being adequately discussed. Such technical terms as catalyst, saturated compound, enzyme, alkaloid, casein, etc., are likely to baffle the beginner, who may also be astonished to learn from the table on p. 16 that the air from Hyde Park is richer in oxygen than that from other sources. The expressions "hydrates of carbon" and "oxyhydrate of lead" are unfortunate, and the description of an amorphous substance in the footnote on p. 227 is apparently meaningless. Many scientific terms which are used in the text are omitted from the index.

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 Classification of the Primates.

IN his letter to NATURE of Jan. 25, Dr. Tate Regan uses the researches of my colleague, Mr. Thornton Carter, as an argument against the validity of the classification of the Primates adopted by Prof. J. P. Hill and myself. In particular, he hints at the possibility of a complete dissociation of the Platyrrhine and Catarrhine monkeys, and their diphyletic origin respectively in America from Tarsioids and in Africa from Lemuroids.

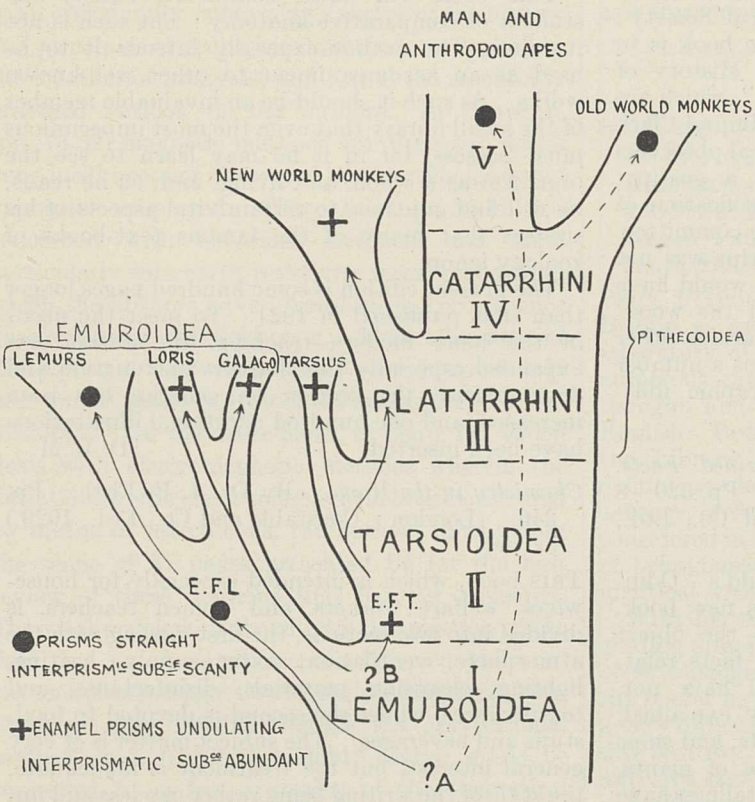

FIG. 1.—Subdivision of the order Primates which developed in the Eocene period.

No one who is aware of the original researches bearing upon the problem, which have been carried on in this department by many investigators during recent years, will expect me to give in detail my reasons for rejecting his iconoclastic suggestion. Tate Regan himself seems to overlook the fact that my letter in NATURE of Dec. 7, 1929, was a commentary on the Croonian Lecture, in which J. P. Hill adduced new and decisive corroboration of the classification, graphically expressed in the accompanying diagram (Fig. 1), which I have been expounding in NATURE and elsewhere for more than a quarter of a century.

The significance of Thornton Carter's brilliant investigation, which Tate Regan has put to such strange uses, is worthy of much fuller study than has hitherto been given to it. To economise space and to help in lucid exposition I have set out his results by inserting crosses and spots on the accompanying diagram. The Lemurs (that is, the members of the sub-order Lemuroidea found in Madagascar, as well as the Eocene fossils, E.F.L., found in America), and the monkeys and apes of the Old World, have enamel characterised by prisms with even edges and a scanty interprismatic substance. In the Lemuroidea found in Africa (Galaginæ) and in Asia (Lorisinæ), the Tarsioidea (both recent and fossil, E.F.T.), and the monkeys of the New World, the enamel prisms have undulating edges and the interprismatic substance is abundant. Thornton Carter has emphasised the profound importance of the histological differences for purposes of classification. If, however, we accept Tate Regan's reference to "the microstructure of the teeth as of primary importance in the classification of the Primates", and, ignoring all other evidence provided by anatomy, embryology, blood-reactions, and susceptibility to disease, break up the natural group of Pithecoidea into two independent phyla, American and African, we ought also to disrupt the Lemuroidea into two independent groups and exclude the African family Galaginæ and the Asiatic family Lorisinæ from the sub-order, which would then be restricted to the Lemurinæ, Indrisinæ, and Cheiromyidæ of Madagascar, with the fossil Lemuroids of America and France.

The affinities of the Lorisiform Lemuroids, the Tarsioidea, and the Platyrrhine monkeys are admitted by most zoologists — all, in fact, except those who insist upon excluding the Lemuroidea from the Primates. The complementary claim, which logically follows if we attach primary and exclusive importance to the evidence of dental histology, that the Mascarene Lemuroids are more nearly akin (than the rest of the Primates) to the monkeys and apes of the Old World, will be repudiated by the vast majority of zoologists, in particular by those mentioned in the foregoing sentence. The facts of embryology given in Hill's recent Croonian Lecture, the new researches on the eye and brain, the well-known evidence provided by the muscles and skeleton, the reactions of the blood, and in fact every department of comparative anatomy and physiology, go to establish the fact that, in the course of their evolution from remote Lemuroid ancestors, the Catarrhine monkeys must have passed through stages which are now known only in the living Platyrrhine monkeys and the Tarsioidea.

The facts of comparative anatomy are fatal to such a classification as Tate Regan adumbrates. Perhaps a concrete illustration will make this consideration plainer. The outstanding factor in the progressive modification of the Primates is a profound revolution in the structure of the brain to give effect to the growing influence of vision and the transference of optic functions from the mid-brain to the cerebral cortex. The morphological effects of this transformation are epitomised in the lateral geniculate body. In the ancestors of the Primates the geniculate body consists of two nuclei of approximately equal size, the ventral linking the optic tract with the old optic mechanisms in the mid-brain, the dorsal with the new cortical formation. In the Tarsioidea, Pithecoidea, and Anthropoidea the growing influence of vision upon behaviour

is expressed anatomically in the expansion and differentiation of the dorsal nucleus, while the ventral nucleus undergoes progressive diminution until eventually it disappears. Woollard has shown (*Brain*, vol. 49, 1926, p. 25) that the enhancement of the biological significance of the eyes in the Lemuroidea (not simply the Lemuridæ, but also the Lorisinæ) is expressed in a hypertrophy of the *ventral* nucleus of the geniculate body while the dorsal nucleus remains insignificant—the direct antithesis of what occurs in the ancestors of the monkeys, which is displayed also in *Tarsius*. This is a certain indication of the fact that the Lemuroidea definitely left the track that led to the Tarsioid and Pithecoid conditions.

This is merely one example (which might be paralleled by scores of others) to illustrate the impossibility of accepting Tate Regan's suggestion. He tells us that he is interested in the subject from " the point of view of a student of geographical distribution ". Yet he hints at the possibility of the evolution of the Catarrhines from a Lemuroid in Africa, where the only known Lemuroids (*Galago* and *Perodicticus*) have enamel of the Tarsioid type, that is, lack the very character upon which his speculation has been erected!

The outstanding fact established by Thornton Carter's and Hill's researches is the strength of the links that bind into one closely knit order all five stages in the progressive evolution of the Primates: (1) Lemuroidea, (2) Tarsioidea, (3) the Platyrrhine Pithecoidea, (4) the Catarrhine Pithecoidea, and (5) the Anthropoidea.

The distinctive characters of the enamel are already developed respectively in the Eocene fossil Lemuroids (E.F.L.) and Tarsioids (E.F.T.) found in America. The earliest Eocene fossil Lemuroids (*Pelycodus* and *Notharctus*) reveal the same peculiarities of enamel as are found in the living lemurs of Madagascar. The Lemuroids of Africa and Asia reveal the other type of enamel. Whether this trait was inherited from some early Eocene (? or Cretaceous) ancestor common to the Loriso-Lemuroids and the Tarsioidea (? B in Fig. 1) or the common character developed independently in *Tarsius* and the Lemuroid *Galago* (by convergence in the two closely related descendants of one remote ancestor) there is no evidence to prove.

Yet the suggestion is illuminating as a possible explanation of the appearance in the monkeys and apes (of the Old World) of the enamel-type found elsewhere in the Primates only in the Mascarene Lemuroids. If the tendency towards the emergence of this character developed in the remote ancestors of the Primates (? A in Fig. 1), shortly before or simultaneously with the contrasted tendency, is it unreasonable to interpret the known facts by the statement that the former was held in check as man's ancestors passed through the Tarsioid and Platyrrhine phases and emerged again only when the Catarrhine phase was reached ?

In his great treatise on the Titanotheres (1914) and elsewhere, Henry Fairfield Osborn has repeatedly directed attention to the fact that in the divergent descendants of a common ancestor, characters which have been omitted in the immediate predecessors may emerge in both lines independently. This variety of convergence is really the manifestation of a (previously latent) tendency which is due to a common origin. The emergence in the Catarrhines of the type of enamel found in the Lemuroidea may be explained in this way. The importance of this character is not diminished by the fact that it was suppressed during the Tarsioid and Platyrrhine phases of Primate evolution. Its interest, moreover, is enhanced by the possibility that it may be linked with other properties of the organism. Thus Tate Regan's contention seems to receive corroboration from the biometricians. In their monograph, " A Study of the Long Bones of the English Skeleton " (1919), Karl Pearson and Julia Bell make the suggestion that the Cebidæ (Platyrrhine monkeys) are derived from a form approximating to the Tarsioidea and " the Simiadæ from a form approximating to the Lemurine group of the Lemuroids " (Sect. II., p. 314). For the reasons already given this suggestion is untenable. Yet it may imply that the peculiarities of the enamel are linked in the evolution of the Primates with the proportions of the femur (and possibly also other features widespread in the whole organism).

The diagram (Fig. 1) affords evidence that I have not overlooked the individuality of the Platyrrhine, Catarrhine, and Anthropoid groups, the distinctions no less than the mutual relations of which have been so lucidly expounded in J. P. Hill's Croonian Lecture.

May I remind Tate Regan of what Huxley wrote in 1860 with reference to another pair of Primate groups: "It would be no less wrong than absurd to deny the existence of this chasm: but it is at least equally wrong and absurd to exaggerate its magnitude, and, resting on the admitted fact of its existence, to refuse to inquire whether it is wide or narrow " ("Man's Place in Nature ").

G. ELLIOT SMITH.

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W.C.1.

The 'Wave-Band' Theory of Wireless Transmission.

MY friend Sir Ambrose Fleming raises an interesting question in his admirably clear article on page 92 of NATURE of Jan. 18, no less a question than whether a mathematical alternative does or does not invariably correspond with some physical reality. I am inclined to think that it does. For example, there is something rotatory in a magnetic field, and whether the rotation of a plane of polarisation may be properly expressed as an acceleration of one circular component and the retardation of another, we have no better mode of expression until we know more. So also I think that a sinuous wave of fluctuating amplitude may be rightly and exactly represented as if it were a band of neighbouring frequencies. This is not obvious; but I would remind Sir Ambrose Fleming that the complete solution of the relevant differential equation for forced vibrations contains not only a simply periodic e^{ipt} term, but one with an evanescent exponential amplitude like e^{-kt} as well; and these latter periodic effects—depending as they do on the natural frequency of the receiver circuit (or on its range of possible frequencies)—though they rapidly die away—are of influence at the beginning and end of a wave series. Dr. Eccles tells me that those initial and final effects are called ' transients ' by electrical engineers; and that is a good name for them.

If we arrange for hyper-selective reception we can deal with a continuous sine wave perfectly; but then it must be continuous, and have neither beginning nor end, and its amplitude throughout must be constant. If the amplitude changes, as when a pure carrier wave is fluctuated by a microphone, it is no longer a pure sine curve; and then transient effects must be taken into consideration, for speech depends on those fluctuations of amplitude. An excessively sharply tuned receiver working at the top of its peaks, so as to exclude everything except the last trace of a single pure tone, may exclude some of the transient effects also, and therefore not give clear reception. Moreover, the amplitude of forced oscillation in the

receiver depends on the tuning, and the equation shows that this must allow for a slight departure from p on either side. An alternative and different way of putting it, is to say that the fluctuations of sinuosity may prolong themselves by a sort of loud-pedal effect, and cause indistinctness; unless some automatic damper can be applied. This might conceivably be possible, by a relayed magnetic field, but meanwhile I suggest that the easiest way of taking the variations of amplitude into account is to express them as the boundaries of a wave-band, to the whole breadth of which the receiver should be competent to respond.

I understand from a private letter that Sir Ambrose Fleming intends to put this to the test of experiment, and see if extremely selective tuning which serves for bass notes will be equally effective for the high-pitched harmonics essential for clear articulation; and vice versa. How wide a band must be to achieve this under customary conditions, I do not know, and I hope he will tell us the result; at present he does not believe in a wave-band at all, and his heresy must be of interest to all wireless experts. I rather sympathise with heresy, and hope he can substantiate this one of his, but I am exceedingly doubtful. The heterodyne method, of regarding a sinuous disturbance of fluctuating amplitude as a superposition of pure tones of slightly different frequencies, seems at first artificial, as he says, but it appears to correspond with experience; and if so, it is an interesting justification of the use of a trigonometrical equivalence familiar to many schoolboys, that "the sum of two sines is equal to twice the sine of half the sum into the cosine of half the difference".

OLIVER LODGE.

Normanton House,
Lake, Salisbury, Feb. 6.

MR. BEDFORD'S letter in NATURE of Feb. 8 appears to me to explain the difficulty raised by Sir Ambrose Fleming's article very clearly, but it is perhaps interesting to give the solution he indicates and evaluate the current set up in a receiver of frequency $r/2\pi$ when receiving a wave of frequency $p/2\pi$ modulated to $q/2\pi$.

If we write $p+q=\lambda$, $p-q=\mu$, the equation to be solved to give the disturbance in the receiver tuned to frequency $r/2\pi$ is

$$\ddot{u}+k\dot{u}+r^2u=\frac{A}{2}\{\sin\lambda t+\sin\mu t\}$$

and the solution is

$$\frac{A}{2}\left\{\frac{\cos\epsilon}{k\lambda}\cos(\lambda t-\epsilon)+\frac{\cos\epsilon'}{k\mu}\cos(\mu t+\epsilon')\right\}+Ce^{-\frac{kt}{2}}\sin\left\{\frac{\sqrt{(4r^2-k^2)t}}{2}+\alpha\right\},$$

where

$$\cos\epsilon=\frac{k\lambda}{\{(\lambda^2-r^2)^2+k^2\lambda^2\}^{\frac{1}{2}}}$$

and $\cos\epsilon'$ has a similar meaning with μ substituted for λ, while C and α depend on the initial conditions. These would normally be $u=\dot{u}=0$, when $t=0$.

Hence if $r^2=\lambda^2=(p+q)^2$,

$$\cos\epsilon=1,\quad \epsilon=0,$$

and the first term in the bracket becomes

$$\frac{1}{k(p+q)}\cos(p+q)t.$$

Thus a receiver tuned to a wave of frequency $(p+q)/2\pi$ will be disturbed by the incidence of a wave of frequency $p/2\pi$ modulated to $q/2\pi$, and unless the ratio of the resistance to the inductance of the receiving circuit is large, that is, unless k is large, the disturbance will be considerable.

Similarly, if $r=p-q$, a note of frequency $(p-q)/2\pi$ will be reinforced.

If r is not equal to λ or μ, disturbances of frequencies $(p+q)/2\pi$ and $(p-q)/2\pi$ will still be produced in the receiver, but the amplitudes will be small.

In any event, then, there will be the two side-band waves which under favourable conditions will produce large effects.

R. T. GLAZEBROOK.

Ballards Oak, Limpsfield,
Surrey.

IN his comments on my letter in NATURE of Feb. 8 Sir Ambrose Fleming makes in rather categorical terms some statements that I think he would be inclined to modify if he could give this question a little more consideration. I would remind him that an unduly selective receiver most certainly *does* fail to reproduce high notes in their proper proportion. The effect is well known and observable at any time by anyone having a receiver in which the reaction is under proper control.

I agree that many receivers are insufficiently selective for practical purposes, but this neither alters the fact that a too highly selective receiver distorts by failing to pick up the side-bands nor proves anything with regard to their non-existence. I would submit, in fact, that theory, laboratory experiment and all practical experience unite in proving that in every sense of the word the side-bands do actually exist and that official regulations must necessarily be based on considerations of width of band as well as of amplitude.

CECIL L. FORTESCUE.

City and Guilds (Engineering) College,
Exhibition Road, London, S.W.7,
Feb. 12.

THE correspondence in NATURE of Feb. 8 (p. 198) on the subject of the wave-band theory of wireless transmission has directed attention to the question of the physical existence of the so-called 'side-bands'. The following experimental results seem to indicate that these 'side-bands' have, in every sense of the word, a very definite physical existence.

(1) It is possible to isolate one of the side-bands at the transmitting station and to transmit it separately, as in the system of single side-band transmission used on the trans-Atlantic telephony service.

(2) Bown, Martin, and Potter (*Jour. Instit. Radio Eng.*, vol. 14, p. 57) transmitted a modulated wave, received the carrier and the two side-bands separately, and showed that the ionised regions of the atmosphere had treated the three component waves in different ways, as if they were physically distinct. It appears that the atmosphere recognises the side-bands as separate entities.

(3) Rupp (*Zeit. für Physik*, **47**, p. 72; 1928) used a modulation method to change the frequency of a light wave, so that it could pass through a selectively absorbing vapour which had stopped the unmodulated wave.

J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge, Jan. 31.

THE correspondence on the existence of the Fourier components of a modulated carrier wave (NATURE, Feb. 8, p. 198) does not seem to have made the subject quite clear. The existence of anything cannot be a mere matter of point of view, neither can the root of the matter be exhibited by the form of the mathematical treatment necessary.

The question at issue seems to be this: Will a disturbance in the 'ether' due to modulating a carrier wave affect receiving circuits tuned to the Fourier components of the disturbance (regardless of whether the circuits be damped or not, that is, of low or high selectivity)? Sir Ambrose Fleming says no; in which case their existence is only mathematical fiction.

The more orthodox argument seems to be as follows. Fourier analysis shows that provided Huygens' principle of superposition holds, a disturbance in the ether due to a modulated carrier wave will be physically indistinguishable as regards amplitude variation from that due to the superposition of sine waves of certain amplitudes and frequencies. It follows that circuits tuned to these frequencies will be affected, and therefore they can be said to exist.

Since, however, in all reasoning from mathematical equations to the physical world we can never be sure that there are not other factors, not represented in the equations, which may affect the conclusions, we have to resort to experiment. The practice of single side-band suppressed-carrier wave transmission, and the experimental resonant 'humps' referred to by Prof. Fortescue, supply sufficient evidence for the existence of the Fourier components. The value of Sir Ambrose Fleming's reply depends on whether makers of wireless sets, in their search for greater selectivity, have yet arrived at a point where the response in the audible range varies sufficiently to counteract the advantage gained by excluding interference from other stations.

G. B. BROWN.

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London, W.C.1,
Feb. 2.

The Connexion of Mass with Luminosity for Stars.

VERY remarkable and fruitful correlations have in recent years been detected, mainly at Mount Wilson, between the magnitudes of stars and their spectroscopic characteristics. The interpretation that would naturally present itself is that magnitude can enter into relation with the radiative phenomena of the surface atmosphere only through the intensity of gravity at the surface, which when great flattens down a steady atmosphere far more than proportionately. But if, following Eddington's empirical relation, total radiation of a star is a function of its mass alone, there must be more than this involved; for the radius of the star persists in this relation when expressed in terms of intensities of surface radiation and of gravity, the former determining the temperature roughly by itself. Modern hypothesis, which treats confidently of an 'electron gas' with an atomic weight, as Ramsay boldly and prematurely proposed long ago, and subject to the Maxwell-Boltzmann exponential energy formula for statistics of distribution, and to its consequences for the theory of dissociation of mixed gases in relation to pressure and temperature, has on the initiative mainly of Saha led to promising applications to stellar atmospheres, which are held to be of densities low enough at any rate not to forbid this mode of treatment.

It would seem then to be necessary to conclude that these empirical spectroscopic relations on the surface require that the stellar atmosphere must be dominated to some degree by the remote steady interior of the star. Accordingly, tentative theories of the internal constitution of the stars and their flux of radiation have been developed in much detail. With Eddington the stars are perfect gases right down to the centre, though the density may there be hundreds of times that of platinum, as has apparently been verified for the case of the companion of Sirius—the high density involving the view at one time not unfamiliar that two atoms can occupy the same space, if the picturesque conception of atoms 'stripped' irrevocably to the bone is to be avoided; and the energy emitted as radiation would come from a dissociation or destruction of matter according to a law involving temperature. On the other hand, it is insisted on by Jeans that the necessary radioactivity for the very long evolutions that are contemplated must be of constant and absolute intensity, else the star would explode: and he has essayed to regard the star as 'liquid' in his investigations, apparently, however, implying a very imperfect gas rather than a special phase with its surface of sharp transition. There are other theories of less statical type.

A determined effort to shed off all such special hypotheses has been published very recently by Milne (*Monthly Notices R.A.S.* for November, pp. 17-53), which accordingly invites close attention and scrutiny. The procedure is the natural one, to try to make continuity between the gases of the atmosphere subject to laws more or less already formulated, and a dense interior about which as little is to be assumed as can be helped. He holds that it suffices merely to consider laws of internal density that are in mechanical equilibrium radially under internal pressure P, of which the fraction $(1-\beta)P$ is pressure of the internal field of radiation. He does not find it necessary to consider how this field of radiation of pressure $(1-\beta)P$ is sustained against loss by outward flux: for if he can arrive at results in terms of surface values that are valid for all such equilibrated densities whether otherwise possible or not, they must hold good for the one that follows the actual law of distribution whatever it may be.

The essential feature, so far as a reader can extract the gist from the complication of formulas that seems to be inherent in these discussions, appears to be that the coefficient β, while increasing rapidly downward in the atmosphere in a manner which can be regarded as known, suddenly rises when a photospheric level is reached, altering with steep gradient until a nearly constant value of β is soon attained for the interior of the star: and the same must apply only in less degree to the density ρ. The condition of mere mechanical equilibrium of the interior is found to express the pressure at the interface between atmosphere and photosphere in terms of values at the centre and one quantity C arising from an integral along the radius involving the arbitrarily assumed law of density. The expression for the atmospheric pressure at the interface involves the same constants in such way that on equating the pressures on the two sides of the interface they divide out of the result and only C remains. This C is held, in the light unforeseen of comparison with facts, to be in some degree a characteristic constant for all the stars, and thus may be the new element beyond surface values, and without assuming anything about their interiors, that the law as formulated requires.

This seems to be right enough in a general way, were it not that the formula for C involves the gradient of density within the star close to the interface, and thus its value must be very substantially changed, in absence of some verification to the contrary, by a very slight radial displacement of the surface which is chosen for that interface. For inside the photosphere ρ is as θ^3, while P which is continuous across the interface is as $\theta^4\phi(\theta)$: so C^{-1} is as the value of $P^{-1}(d\rho/dr)^2$ in which the second factor is the internal gradient, at the surface. If this consideration be correct it would appear that it is not legitimate to connect the chromosphere with the interior across a

sharp boundary surface, as if they were different phases of matter like a liquid and its vapour. This conclusion would involve that the formula itself for C cannot be well founded: and the reason can be assigned, that the transition from Milne's formula (21) to (22) is invalid because the interior gradient of ϕ at the interface is very large and cannot be neglected even when multiplied by θ. Apparently one can only assert that the mass of the star involves the value of dP/dr within the photosphere and other quantities relating to the centre of the star, and the luminosity involves the value of P outside it, while the pressure P is continuous across a transition but not dP/dr.

In any case, perhaps not much stress would be laid on the deduction. The formula is regarded probably by its author as essentially an empirical result. When the value of C had been adapted to two prominent stars, the Sun and Capella, it turned out in his hands, as he relates, to his astonishment, that it was a universal constant the same for all stars, and if so perhaps not connected with their interior constitutions at all.

JOSEPH LARMOR.

Cambridge, Jan. 18.

The Tesla-Luminescent Spectrum of Benzene.

IN a recent letter to NATURE (Sept. 7, 1929), Shapiro has pointed out that Riemann's wave numbers for the fluorescence spectrum of benzene (*Ann. d. Phys.* **80**, 43; 1926) could be expressed by formulæ of the type

$$\nu = 37494 + 921n' - 998n_1'' - bn_2'',$$

where b takes the values 0, 600, 855, and 1180 in four series and n', n_1'', and n_2'' have appropriate small integral values.

It may be of interest to note that similar formulæ hold for the band heads in the emission spectrum of benzene. The experimental data were obtained during the tenure of a Commonwealth Fund Fellowship when I collaborated with Dr. J. B. Austin in an investigation of the tesla-luminescence spectra of organic compounds at Yale University. The experimental method we employed differed in many respects from that of M'Vicker, Stewart, and Marsh (*J.C.S.*, T. **123**, 642; 1923) and gave much sharper band heads. The error in the wave numbers, which were determined independently by Austin and myself, is probably less than 5 cm.$^{-1}$, in the case of the reasonably strong and well-defined bands. Out of a total of about 110 bands recorded, 87 are satisfactorily accounted for by the formulæ:

$$(a)\ \nu = 38613 + 924n' - 161n'' - 994n'''$$
$$(b)\ \nu = 37547 + 924n' - 161n'' - 986n'''$$
$$(c)\ \nu = 36476 + 924n' - 160n'' - 990n''',$$

where n', n'', and n''' have integral values from 0 to 6.

It is noteworthy that the bands which are not accurately expressible by these formulæ are, without exception, situated in a part of the spectrum where the bands are faint, and consequently the accuracy of measurement is low. It is in general true that the faint bands occur where the quantum numbers are simultaneously large. In the most intense system—formula (*b*)—the band represented by the quantum number (0,0,0) is *not* observed: faint lines are, however, represented by the numbers (0,0,1) and (0,1,0). The strong band heads in this system begin with an intense band and in approximate agreement with the wave number 37485 given by (1,0,1). This value corresponds to the $\nu_0 = 37494$ given by Henri ("Structure des Molecules", 1925).

There are five vibrational frequencies in the above formulæ, 924, 161, 986, 990, and 994, and these are in approximate agreement with similar constants in previous work on the various spectra of benzene. Thus, 921 occurs in Henri's absorption work, and was used by Shapiro in the interpretation of the fluorescence spectrum. 163 is a vibrational number employed by Riemann in formulæ for the fluorescence spectrum, and 164·5 occurs throughout M'Vicker, Stewart, and Marsh's work on the emission spectrum. Finally, 987 appears in the formulæ of M'Vicker, Stewart, and Marsh, and 998 is given by Shapiro.

In his letter to NATURE, Shapiro has directed attention to the agreement between his vibrational frequencies 600, 855, and 1180 and the Raman values 605, 853, and 1176. It may be noted that these numbers can be obtained with considerable accuracy by the combination of the vibrational frequencies in the present work. In conclusion, these constants appear to be related to frequencies in the infra-red spectrum of benzene; a result which has already been indicated by M'Vicker, Stewart, and Marsh in the case of their constant 164·5.

It is hoped to publish elsewhere, in conjunction with Austin, a more detailed account of these results, as well as a description of the experimental investigation, and to extend the work to some benzene homologues for which new experimental data are available.

IAN ARMSTRONG BLACK.

Physics Laboratory,
The University,
St. Andrews,
Jan. 23.

Gaseous Combustion.

IT is interesting to learn, from the letter which in conjunction with Mr. W. Davies he published in NATURE of Jan. 25, that my friend Prof. W. T. David seems to be coming round to an interpretation of his experimental work not unlike, although more advanced than, that which I suggested to him some five years ago as an alternative to the one of 'after-burning', as distinguished from 'dissociation', which he had then put forward.

Many of those present at the meeting of the Institution of Mechanical Engineers in London on Oct. 24, 1924, when a paper by Prof. David, on the "Missing Pressure and Heat Losses in Gas Engines" was read and discussed, will recall that he then regarded his work as proving that (to quote his words) "even under the ideal conditions obtainable in a closed vessel some 10 per cent of the gaseous fuel (coal gas) is unburnt at the moment of maximum pressure and that, therefore, incomplete combustion, in addition to increasing specific heat and heat loss, must be regarded as an important factor in limiting the pressure development".

In a written contribution to that discussion (*Proc. Inst. Mech. Eng.*, pp. 806-9; 1924) I ventured to criticise such conclusion, saying that it was by no means the only possible interpretation of Prof. David's experimental results, and that "Other equally probable alternative explanations (as, for instance, the assumption of a different distribution of the total energy, as between vibrational, rotational and kinetic kinds, of steam and carbon dioxide molecules at their moment of formation in the neighbourhood of the maximum pressure from that pertaining to the same molecules when in true equilibrium at the same temperature but at some considerable interval of time after their formation in combustion would equally well satisfy such facts". Also, I said that, so far as I could see, "there was nothing in the results of Prof.

David's experiments which would enable them to discriminate at all between the possible alternative explanations. Therefore whilst Prof. David had preferred the particular interpretation put forward in his paper, he would have been equally justified by his facts in adopting (had he so chosen) another which some might regard as equally or even more probable than his own". In reply Prof. David rejected my proffered alternative, because (he said) "the rate of partitioning of energy at the high temperature of explosion must be exceedingly rapid, and thermal equilibrium would set in almost instantaneously".

The alternative view, which I have long held, was further elaborated in the following paragraph on p. 202 of the book on "Flame and Combustion in Gases", by Dr. D. T. A. Townend and myself in 1927: "When an explosive gaseous medium in equilibrium with its environment is ignited, a very sudden and violent change occurs, whereby new molecules are born at a high temperature in an intensely vibrational condition. It is probable that, in the first instance and momentarily, the energy of the newly-born molecules is mainly internal; and that a certain time interval must elapse, during which a rapid process of adjustment between the internal and kinetic energies occurs, before the medium re-attains a steady state of equilibrium with its environment. Indeed, it may be said that, in general, if T be the maximum mean temperature of the medium on explosion, in all probability its 'energy distribution state' is momentarily different from that which would result had the products of combustion merely been heated up to that temperature. In other words, it is generally agreed that the chemical changes occurring in flames and explosions do generate molecular systems whose energy is, in the first instance, largely vibrational; and that a definite, though it may be small, time interval must elapse before the energy becomes mainly kinetic, and the system re-attains equilibrium with the environment".

In supposing the formation of 'long lived' molecules of carbon dioxide and steam of 'abnormal structure', Prof. David and Mr. Davies have extended the foregoing view much further than I would be prepared to go, especially as regards the 'long life' of the supposed metastable molecules. Also, in saying that luminosity was manifested in their exploded gases "at a time long after that at which combination (as inferred from the chemical analysis of rapidly cooled samples) has been completed", they would seem to have modified the former view about the so-called 'after burning', in the sense that it seems now to be ascribed to incompleteness of the energy development (because of that held up in the supposed metastable molecules) rather than to that of the actual oxidation itself at the moment of maximum pressure.

While reserving any further comments on the matter until after I have studied the evidence adduced in their forthcoming paper, perhaps I may be allowed to put in a caveat that in 'closed-vessel' explosions the relative times for complete inflammation, for the attainment of maximum pressure, and for the cessation of luminosity in the medium, so largely depend upon such factors as shape and size of the enclosure and the occurrence of compression waves, that due caution should be exercised in judging the significance of particular experimental data, especially where the vessels used are larger than would allow of substantial homogeneity throughout the medium at the moment of maximum pressure.

WILLIAM A. BONE.
Imperial College of Science and Technology,
London, Feb. 10.

Dissociation Energy of Oxygen Determined from the Pre-Dissociation of Sulphur Dioxide.

THE absorption spectrum of sulphur dioxide vapour, which we are studying with Wieland, is composed of three electronic regions: the first 3900-3400 which appears at high pressure (1 atmosphere and more in a tube of 100 cm.); the second 3370-2450, which begins to appear at $p = 0{\cdot}1$ mm., and the third from 2350 extending beyond 2000 for low pressures 0·02-10 mm.

The first and third regions are made up of series of bands with a fine rotation structure. The second region is also made up of bands with fine structure, but between 2550 and 2500 the bands become broad and diffuse. The molecule is then pre-dissociated.

If we assume that this pre-dissociation limit corresponds to the reaction:

$$SO_2 \rightarrow SO + O$$

the heat of this reaction must be between 111,000 (2550) and 114,000 (2500) calories, the mean value being 112,500 cal.

We have studied with F. Wolff (*Jour. Phys. et Rad.*, March 1929, p. 81) the spectrum of SO, and have calculated from the convergence limit of the normal term the heat of normal dissociation, $SO \rightarrow S + O$ − 148,000 cal.

From the sharp limit of pre-dissociation at 2792 which we obtained in the absorption spectrum of S_2 vapour, we can calculate the heat of dissociation of sulphur: $S_2 \rightarrow S + S$ − 102,200 cal. This value is in agreement with the thermal determination 103,600 (Budde, *Zeit. an. Chem.* **78**, 169; 1912). The heat of reaction $\frac{1}{2}S_2 + O_2 \rightarrow SO_2$ is 83,000 cal. (Ferguson).

The heat of dissociation of oxygen is, therefore,

$$148{,}000 + 112{,}000 - \frac{102{,}200}{2} - 83{,}000 =$$

126,400 cal. (5·5 volt).

This value is in good agreement with the determination which we made from the pre-dissociation of NO_2 (128,000 cal.) (NATURE, Feb. 8, p. 202).

It is very probable that the third absorption region of SO_2 presents also a pre-dissociation limit corresponding to the reaction:

$$SO_2 \rightarrow SO + O^*$$

We have found that the energy level of the metastable 1*D* oxygen is equal to 13,700 cm.$^{-1}$ (NATURE, Feb. 8). The second pre-dissociation must then occur between 1800 and 1900 A. We are studying it now with the vacuum spectrograph.

VICTOR HENRI.
Institute of Physical Chemistry,
Zurich.

Non-Disjunction Produced by Carbon Dioxide.

THE abnormal mitoses seen in tissue cultures kept under high tensions of carbon dioxide were described in a communication in NATURE of Mar. 17, 1928, p. 420 (see also *Brit. J. Exp. Path.*, **9**, 240; 1928). Fragmentation of the chromosomes and irregular migration of the chromatin to the controsomes were seen, exactly similar to the mitotic changes observed many years previously in the eggs of *Ascaris megalocephala* subjected to radium (*Arch. Middx. Hosp.*, **30**, 98; 1913). These observations suggested that carbon dioxide might produce hereditary disturbances, when applied to germ cells, analogous to those produced by X-rays and radium. In order to test this, observations on non-disjunction in *Drosophila* have been made, in which newly hatched virgin red-eyed flies were subjected to either pure carbon dioxide for a few hours,

or to varying mixtures of air and carbon dioxide for longer periods of time. They were then crossed with white-eyed males, and allowed to breed.

In the experimental series, 9 exceptional sons in 3930 sons were found, in the corresponding controls 2 exceptional sons in 4880. Using the formula given by Karl Pearson (*Phil. Mag.*, 6th Series, **13**, 365; 1907), $\sqrt{\frac{m}{n}\left(p+1\right)\left(1+\frac{m}{n}\right)} \times 0{\cdot}6745$ equals the probable error of difference, it is calculated that the difference between the mean number of exceptional sons expected from the control series and the actual number of exceptional sons of the carbon dioxide treated flies is equal to 4·66 times the probable error. Among the corresponding daughters two *gynandromorphs* were found, both in the experimental series, none in the controls.

In view of this effect of carbon dioxide on non-disjunction, there is reason to think that it will produce other chromosomal disturbances, and alter germ cells in a manner similar to X-rays ; and I write in the hope that those who have facilities for the study of the production of mutations will give carbon dioxide a trial. For those who are working upon ' the somatic mutation ' hypothesis for cancer these results are of special interest, in that they provide a way for the production of somatic mutations other than by X-rays and radium. J. C. MOTTRAM.

The Radium Institute, London,
Jan. 15.

Mounting Medium for Film Sections.

IN the photomicrography of film sections for the purpose of examining the edge of the section, difficulty is encountered in the case of nitrate base when ordinary benzol- or xylol-balsam is used as the mounting medium, owing to the refractive index of the medium being very close to that of nitrate film. A mounting medium of high refractive index ($N_D = 1{\cdot}591$) suitable for photomicrographing sections of nitrate film is made up as follows :

10 cm.^{3} of alphabromonaphthalene is added to 15 gm. of dried Canada balsam in a glass-stoppered or ' balsam ' bottle. The mixture is heated on the water-bath until the balsam has melted. Gentle agitation will then cause the liquid to become homogeneous.

This highly-refracting balsam will find other applications in microscopy, for example, for use with Diatomaceæ and micro-crystals.

For the photomicrography of sections of acetate film, benzol- or xylol-balsam is satisfactory.

EDWIN E. JELLEY.

Research Laboratory,
Kodak, Ltd., The Works,
Wealdstone, Middlesex, Jan. 16.

A Probable Band Spectrum of Neon.

HERZBERG has recently suggested (*Zs. f. Phy.*, vol. 57, p. 626) from theoretical considerations that two excited neon atoms may combine to form a neon molecule, just as two excited helium atoms combine to form a molecule of helium, yielding a band spectrum discovered by Goldstein in 1913, and the subject of numerous researches in recent years by Curtis, Dieke, Takamine, Weizel, and others. It may be interesting in this connexion to note that while working with a neon discharge tube supplied by Leyboldts Nachfolger, Cologne, I obtained about a year ago a number of bands in the red which appear to be due to neon molecules. The bands appeared under a transformer discharge, and disappeared when the discharge was sent from an induction coil.

The bands are rather peculiar, as they show no head, and consist of a number of lines at equal frequency intervals. Apparently the Q-branch is entirely missing ; only the P and R branches are developed. The bands are approximately at 7393, 7208, 7063, 6963, 6847, and seem to be associated with strong red lines of neon. The frequency difference between the successive lines is approximately 6 units, from which the moment of inertia comes out to be 18×10^{-40} cm.^{2}gm., and the distance between the neon atoms comes out to be of the order 1×10^{-8} cm. The distance between the atoms of the Na_2 molecule is stated by Birge to be $2{\cdot}33 \times 10^{-8}$ cm. Since the electron in the excited neon comes from a closed shell, its distance from the nucleus should be much less than that of the electron in Na_2, and this is in accordance with my result. D. G. DHAVALE.

Department of Physics,
University of Allahabad,
Dec. 18, 1929.

Preparations of Protozoa and Algæ.

WITH reference to Dr. Ll. Lloyd's method of obtaining preparations of protozoa and algæ (NATURE, Jan. 18, p. 91), I have used a similar method since 1926 for the study of growths of sessile algæ. I demonstrated this method in a paper to Section K (Botany) of the British Association at the Glasgow meeting in 1928.

Glass microscope slides 1-inch wide and of the suitable length are fitted in a metal photograph printing frame and either wired (or chained) on the bed of the river or buoyed at a certain level with corks. After a given period the frame is lifted out and the slides can be fixed and treated in the same manner as other microscopic preparations.

I believe the first to use glass slides for this kind of work was Nauman (see *Ber. Deutsch. Bot. Ges.*, **37**, 76-78 ; 1919). R. W. BUTCHER.

The Tees Laboratory,
Barnard Castle,
Durham, Jan. 30.

Wild Birds and Butterflies.

APROPOS of the recent discussion in NATURE as to the frequency with which butterflies are eaten by birds, the following extract from *The Emu*, **29**, Pt. 3, October 1929, p. 88, may be of interest. The writer is Mr. M. S. R. Sharland, Melbourne, and the species of bird is the dusky wood-swallow (*Artamus cyanopterus*). " When almost full-fledged they (*i.e.* the nestlings) were fed at frequent intervals on butterflies. This was the first time I had noticed butterflies being included in the menu of either adult or young birds. The wood-swallow is evidently immune from any objectionable sensations to the palate which the butterfly may cause, but these insects seem to be shunned by most birds." J. B. CLELAND.

The University,
Adelaide, Dec. 24, 1929.

Insect Pests of Willows.

IN a letter in NATURE of Feb. 8, p. 201, by H. P. Hutchinson and myself, a serious error in the proof escaped notice. *Galerucella luteola* Müll was quoted as a common pest of *Salix triandra* varieties in Great Britain. The species, of course, should have been *G. lineola* Fabr. The former Chrysomelid beetle is common on the Continent and is not indigenous to Great Britain. H. G. H. KEARNS.

The University,
Bristol.

The Function of Phosphate in Alcoholic Fermentation.[1]

By Prof. ARTHUR HARDEN, F.R.S.

THE discovery that phosphates play an essential part in alcoholic fermentation arose out of an attempt by the late Dr. Allan Macfadyen to prepare an anti-zymase by injecting Buchner's yeast juice into animals. As a necessary preliminary to the study of the effect of the serum of these injected animals on fermentation by yeast juice, the action of normal serum was examined. It was thus found that this exerted a two-fold effect; in its presence the action of the proteolytic enzymes of the yeast juice was greatly diminished, and at the same time both the rate of fermentation and the total fermentation produced were considerably increased.

In the course of experiments made to investigate this phenomenon, which it was thought might have been due to the protection of the enzyme of alcoholic fermentation from proteolysis by means of an anti-protease present in the serum, the effect of boiled autolysed yeast juice was tested, it being thought that the presence of the products of proteolysis might also exert an anti-proteolytic effect. As my colleague Mr. Young, who had by this time joined me, and myself had fortunately decided to abandon the gravimetric method chiefly used by Buchner in favour of a volumetric method which permitted almost continuous observations, we were at once struck by the fact that a great but temporary acceleration of the rate of fermentation and an increase in the carbon dioxide evolved proportional to the volume of boiled juice added were produced. This was ultimately traced to the presence of two independent factors in the boiled yeast juice, a thermostable dialysable coenzyme, now often known at the suggestion of Euler as co-zymase, and inorganic phosphate.

With regard to the phosphate, subsequent experiments showed that in all fermentations brought about by preparations obtained from yeast the presence of phosphate is absolutely essential. Leaving aside the question of living yeast for consideration later on, three different types of fermentation can be established (Fig. 1, curves 1, 2, and 3) with such preparations.

(1.) A relatively rapid fermentation (Fig. 1, curve 1) in which sugar is decomposed into carbon dioxide and alcohol and simultaneously inorganic phosphate is converted into an ester (or esters) of a sugar which accumulates. The rate rises to a maximum, and when the supply of inorganic phosphate ceases, the rate of fermentation falls, the accumulation of ester also naturally ceases and the fermentation passes into Type 2.

(2.) A relatively slow fermentation (Fig. 1, curve 2) in which the rate at which fermentation occurs is controlled by the rate at which inorganic phosphate is supplied by the hydrolysis of the phosphoric esters present in the system by the phosphatase also present. This inorganic phosphate is alternately reconverted into a sugar-phosphoric ester and again liberated by hydrolysis, and thus fermentation proceeds at a steady rate in the presence of available sugar without any permanent increase in the amount of inorganic phosphate or of phosphoric ester present. This is the type of fermentation which goes on when sugar is added to an active preparation from yeast and the process is allowed to proceed until a steady rate is obtained. In some preparations, depending on the amount of phosphatase present, the rate of fermentation is increased to some extent if more of the sugar-phosphoric ester is added or produced (Boyland, *Biochem. J.*, **23**, 219; 1929), but this soon reaches a limit. If inorganic phosphate be added, the fermentation passes into Type 1. If sugar fails, inorganic phosphate appears and ultimately (under favourable conditions) the whole of the sugar-phosphoric ester is hydrolysed, its sugar moiety fermented and the whole of the phosphate liberated in the inorganic form.

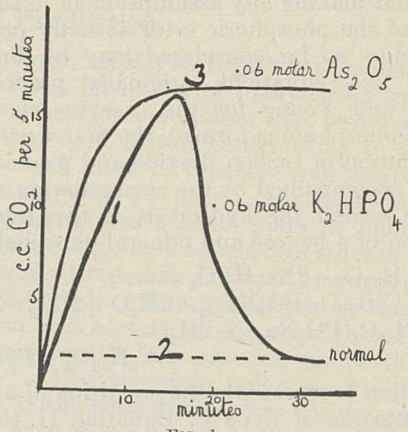

FIG. 1.

(3.) If now into a fermentation mixture in which a Type 2 fermentation is proceeding an additional quantity be introduced of a phosphatase, capable of hydrolysing the sugar-phosphoric ester and thus increasing the rate of supply of inorganic phosphate (Harden and Macfarlane, unpublished results), the rate of fermentation also rises. If a sufficiently active preparation of phosphatase could be added so that the sugar-phosphoric ester was decomposed as rapidly as it was formed, a rapid fermentation would ensue, unaccompanied by accumulation of phosphoric ester. This has not yet been accomplished directly, but an indirect method of attaining the same end is available, inasmuch as arsenates have been found to have the power of greatly stimulating the effect of the phosphatase.

This observation was in reality the undeserved reward for thinking chemically about a biochemical problem. In many chemical reactions the type of compound concerned is the main fact of importance; arsenates react like phosphates; potassium may be replaced by sodium, iron by nickel or cobalt. Biochemically, the difference between potassium and

[1] Address delivered at Stockholm on Dec. 12, 1929, on the occasion of the presentation of the Nobel Prizes.

sodium may be the difference between life and death, and when iron is not used in a respiratory pigment it is not replaced in Nature by nickel or cobalt, but by copper or vanadium. So, also, arsenate does not play a similar part to phosphate in fermentation, but acts in an entirely different manner. On the addition of a suitable amount of arsenate a rapid fermentation (Fig. 1, curve 3) occurs comparable in rate with that of Type 1, but differing from this in that the rate is permanently raised and that no accumulation of the sugar-phosphoric ester occurs. Under optimal conditions the addition of inorganic phosphate does not produce any significant rise in this rate of fermentation, as the rate of fermentation is controlled in these circumstances by the concentration of the fermenting complex (enzymes + co-enzyme). Arsenate, on the other hand, does not increase the maximum rate in fermentation of Type 1, as the supply of inorganic phosphate is already optimal.

Without making any assumption as to the exact nature of the phosphoric ester actually produced, the changes so far considered may be illustrated by the two equations originally proposed by Harden and Young for the case in which only hexosediphosphate is formed, the first representing the evolution of carbon dioxide and production of alcohol, accompanied by the accumulation of ester, and the second the hydrolysis of this ester with liberation of a hexose and mineral phosphate.

I. $2C_6H_{12}O_6 + 2Na_2HPO_4 = C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O + 2CO_2 + 2C_2H_6O$

II. $C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O = C_6H_{12}O_6 + 2Na_2HPO_4$

Equation I. represents the condition of affairs in a fermentation of Type 1; Equation II. that in a fermentation of Type 2. In the presence of arsenate, the hydrolysis of hexosephosphate according to Equation II. proceeds sufficiently rapidly to supply phosphate at such a rate that Equation I. proceeds at maximum velocity.

Fermentation by Living Yeast.

A striking feature of fermentation by yeast preparations is that it proceeds much less rapidly than fermentation by a corresponding amount of living yeast. Thus Buchner's yeast juice ferments at only about 1/20-1/40 of the rate of the yeast from which it is derived.

The fact that the rate of fermentation of such a juice can be raised in favourable circumstances some ten to twenty times simply by increasing the supply of phosphate seems to me to indicate clearly that a large fraction, at least half, of the fermenting complex of the yeast has escaped injury in the preparation and has passed into the juice, but that the mechanism for the supply of inorganic phosphate has been to a large extent destroyed. Neither arsenate nor phosphate has an accelerating action on the rate of fermentation by living yeast. This may be due to the fact that the supply of inorganic phosphate in the interior of the yeast cell is already optimal, but some doubt exists as to whether or not these salts freely penetrate the cell. If, however, as seems to me probable, it is true that in the making of preparations from yeast it is the phosphate-supplying mechanism that is thrown out of gear, it becomes an object of inquiry in what way this is brought about.

Several possibilities present themselves. As suggested for the fermenting complex itself by Euler and his colleagues, the phosphatase may in large part be combined with the cytoplasm and thrown out of action when the cell is killed. Another possibility is that in the cell the action is localised and that disorganisation of the cell leads to less favourable conditions (for example, concentration, presence of inhibitors, etc.) and to lessened rate of action. There is some evidence for this, since the amount of phosphatase present, as judged by the normal rate of fermentation (Type 2), seems to diminish as the disorganisation of the cell becomes more complete. Thus dried yeast and yeast dehydrated with acetone ferment sugar (Type 2) more rapidly than yeast juice, although when phosphate

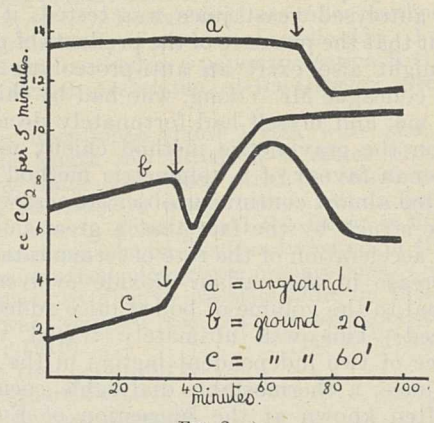

FIG. 2.

is freely supplied they all cause fermentation at about the same rate. Again, some labile substance which acts as an accelerator of the phosphatase may be inactivated by the various modes of treatment (grinding, drying, treatment with toluene or acetone, etc.) to which the cell is subjected.

The process least likely to activate such an accelerating substance is probably that of Buchner, but the possibility also exists that such a substance, if present, might be adsorbed and thus removed from the juice by the large quantity of kieselguhr employed.

Experiments (not yet published) have recently been made in my laboratory by Miss Macfarlane to find out at what stage in the process the change occurs and whether a juice richer in phosphatase could be obtained by modifying the process of grinding and pressing out. It appears, however, that simple grinding with sand produces a change of the same order as that observed in Buchner's yeast juice. The experiments were made by grinding a mixture of sand and yeast for different times and testing the rate of fermentation and response to phosphate at intervals of the whole mass without pressing out (Fig. 2).

These curves show the rate of fermentation of

2 gm. of yeast + 2 gm. of sand in 20 c.c. of 10 per cent fructose at 30° ; (*a*) without grinding ; (*b*) after grinding for 20 minutes ; and (*c*) after grinding for 60 minutes. At the point marked with an arrow 0·6 c.c. of 2*M* potassium hydrogen phosphate was added. The curves show that the longer the period of grinding, the lower the rate of fermentation and the greater the response to phosphate. Here again the total loss of fermenting power was only small.

Minor differences were observed when different substances were substituted for the kieselguhr used by Buchner, the most active juice, for example, being obtained by the use of calcium carbonate, whereas barium carbonate yielded totally inactive material. Further investigation may possibly throw more light on this aspect of the question.

I have assumed up to now that the processes in the living cell are essentially of the same kind as those which occur in the various preparations made from the dead cell, but differ from these mainly in the relative intensity of some of the reactions, and I know no valid argument against this assumption.

The cycle undergone by the phosphate in the series of changes which constitutes ordinary fermentation clearly consists in the alternate formation of a phosphoric ester and the hydrolysis of this to free phosphoric acid. A simple calculation based on the phosphorus content of living yeast shows that the whole of this phosphate must pass through the stage of phosphoric ester every five or six minutes in order to maintain the normal rate of fermentation, whereas in an average sample of yeast juice the cycle, calculated in the same way, would last nearly two hours.

(*To be continued.*)

Hybrid Vigour and Fibre Production.

MAN may not consume more vegetable food per capita now than in days past, but it is certain that the amount of vegetable fibre employed to clothe him, and to spread before his eyes the printed word, increases from year to year, and the subject of vegetable sources for our cellulose supplies is frequently canvassed as a result.

In a very interesting and suggestive chapter in their text-book "Genetics in Relation to Agriculture", Messrs. Babcock and Claussen, two distinguished geneticists of the University of California at Berkeley, point out that rapid vegetable growth, in all kinds of plants is frequently very marked in the first generation hybrid offspring of crosses between species or varieties; it is impossible to define the procedure too accurately in view of the confusion that surrounds the taxonomists' definition of a species, but these authors were referring to a familiar phenomenon which very early received attention in the history of breeding experiments.

The rapid production of cellulose for the voracious maw of the printing press depends upon the rapid growth of the plant, and in America, following the lead of such geneticists as Babcock and Claussen, the foresters are exploring the possibilities of hybridisation as the source of an F_1 generation of trees which shall grow more quickly than either parent. The intention, of course, is to propagate such a vigorous seedling when procured by vegetative means. In such a 'clone' of vegetatively propagated trees the hybrid vigour of the original plant may be expected to persist, and when, as in the case of the paper pulp industry, the essential point is quantitative yield of wood, to a certain extent regardless of quality, the problem is relatively clear-cut and there seems considerable possibility of attainment of the practical end in view.

Where, however, plants of briefer duration of life are concerned, and where each new generation of plants is raised from seed, at first sight the possibility of obtaining more-vigorously growing plants as the result of hybridisation seems very remote. As is well known, in subsequent generations, the Mendelian growth factors, combined in the F_1 hybrid, usually segregate independently and there is little likelihood of many seedlings of the new F_2 generation containing that happy summation of dominant factors contributing to vigorous growth which were fortunately combined by the cross making the F_1 plant. However, in recent years numerous cases have come to light where many factors, thus first brought together in a cross, have remained together during subsequent generations as the result of that obscure process controlling the fusion and sorting of the constituents of the chromosome which are grouped under the term 'linkage'. It is, therefore, perhaps worth pointing out that at the present time two plants which are or have been under trial as sources of fibre may represent the offspring of a natural hybrid.

Prof. F. W. Oliver, now enjoying his well-earned rest from the Department of Botany, University College, Gower Street, by taking charge for a short period of the Botanical Department of the University of Cairo, has frequently directed attention to the vigorous growth of one of these plants—rice grass or cord grass, *Spartina Townsendii*.

Three articles upon this grass, upon its distribution, its use in reclaiming maritime muds and resisting foreshore erosion, and as a fodder, etc., appeared in the *Journal of the Ministry of Agriculture* recently, and were reprinted by the Ministry as Miscellaneous Publication No. 66; whilst, during the War, experiments were made with this plant in paper-making. As Prof. Oliver points out in his contribution in these articles, we are still uncertain of the accuracy of the assumption that this grass arose as a hybrid between the species *S. alterniflora* and *S. stricta*, experiments made in crossing the putative parents having so far been without result. If a hybrid, it is at least remarkable that no segregates have been discovered during the fifty years in which the spread of *S. Townsendii* has now been observed.

In the other case, the plant in question is under much more vigorous exploitation as a fibre plant. 'Brotex' was referred to in NATURE of Mar. 9, 1929. Its botanical history is far less known than

that of *Spartina Townsendii*, as its examination has been conducted for commercial rather than scientific ends. We are told, however, that this malvaceous plant is a hybrid biennial which comes true to seed and can be grown successfully in Devonshire, with vigorous production of fibre. The Brotex Company, of 10 New Burlington Street, London, has issued a booklet containing some very striking photographs of the plant under cultivation at Totnes, Devonshire. There seems little doubt also that a valuable fibre can be obtained from the plant; it has still, of course, to establish its place as a commercial source of fibre.

Again, we seem to be confronted with a case of vigorous cell wall production by a plant of hybrid origin. If the claims for the plant are justified and this vigour of growth maintained in subsequent years, as in the case of *Spartina*, once more the question arises whether linkage has established amongst the hybrid offspring a stable and vigorous race of plants.

Another alternative in such cases has to be borne in mind, and will doubtless form the subject of future investigation. In *Citrus* and in many other genera of plants, it is possible to maintain a hybrid race intact, although propagating by seed, because these seeds are actually asexually produced, so that though 'seed' is planted, the plants are actually members of one vegetatively propagated 'clone'.

The whole subject of the utilisation of hybrid vigour, for fibre production as for fruit and vegetable production in the service of man, is a fascinating topic fraught with great practical possibilities. In view, especially, of the utilisation of Britain's tropical resources, it is to be hoped that its investigation will not be left to America; but, on a conservative estimate, twenty times the number of scientific workers are engaged in the study of plant genetics in the United States compared with the number of workers in this field in the British Empire.

Obituary.

Mr. E. T. Newton, F.R.S.

EDWIN TULLEY NEWTON, who died in London on Jan. 28, aged nearly ninety, was for many years a leader in the study of fossils in Great Britain. He was born in London in May 1840, and at an early age was apprenticed to a handicraft which gave him special skill in designing and carrying out delicate manipulations. He was at the same time deeply interested in natural history, and was fortunate in attracting the notice of Huxley, whose lectures he attended at the Royal School of Mines in Jermyn Street. Eventually, in 1865, he became assistant to Huxley, who was then naturalist to the Geological Survey, and henceforth he was able to follow his inclination and devote himself to the study of life, both recent and fossil. His official work, however, led to his dealing chiefly with fossils, and in 1882, when Mr. Robert Etheridge left for the British Museum, he was appointed palæontologist to the Geological Survey, a position which he occupied until his retirement under the age-limit in 1905.

Newton's earliest noteworthy success, arising out of his routine duties, was the preparation of the first satisfactory microscope-sections of coal, for use by Huxley in a lecture which he delivered at Leeds in 1870, and afterwards published in the *Contemporary Review*. These sections aroused much interest, because they revealed masses of spores as the chief constituent of certain bituminous coals, and Newton followed up the subject in his first scientific paper, which was published in the *Geological Magazine* in 1875. Next he turned to the difficult task of preparing a regular series of transverse sections through the brain of a cockroach, which he described, with the aid of his own drawings, in the *Quarterly Journal of Microscopical Science* in 1879. Each of these sections represented a known thickness, and Newton reproduced them exactly on an enlarged scale in a series of plates of soft pinewood. He then fixed the wooden plates together in regular order, and thus made a magnified model of the cockroach brain, which he described in the *Journal of the Quekett Microscopical Club*. This was one of the first attempts to make a model from serial sections, and it is now preserved in the Museum of the Royal College of Surgeons.

Newton's chief official duty as palæontologist to the Geological Survey, like that of his colleague George Sharman, was the preparation of lists of fossils for the memoirs which accompanied the maps. Throughout his career, however, he did much more than official routine, and found both time and opportunity to make many important contributions to our knowledge, especially of the fossil Vertebrata. His earliest researches of this kind were devoted to the Cretaceous fishes, and he published his results not only in short papers, but also in his well-known memoir on the "Cretaceous Chimæroid Fishes", issued by the Geological Survey in 1878, and in the second edition of Dixon's "Geology and Fossils of Sussex", which appeared in the same year.

Most of the English Cretaceous fish-remains were fragmentary, and Newton was always fascinated by fragments, which needed special skill and patience for their interpretation. He was particularly interested in the scattered remains of the small mammals, birds, and fishes found in the later geological formations; and as the museums of London proved to be deficient in the skeletons of common existing animals which he wanted for comparison, he proceeded to make his own collection. He thus brought together a valuable series of exquisitely prepared skeletons, which included parts often neglected, such as the otoliths of fishes. Aided by this collection, he made great additions to our knowledge of the vertebrate fauna of Britain which immediately preceded the present, and his services were frequently sought when isolated bones and

teeth were discovered in cave deposits and other comparatively recent geological formations. In this connexion may be specially mentioned his Survey memoirs on "The Vertebrata of the Forest Bed Series of Norfolk and Suffolk" (1882) and "The Vertebrata of the Pliocene Deposits of Britain" (1891), also his paper on the Pleistocene vertebrates from the Ightham fissure in Kent contributed to the Geological Society's *Journal* in 1894. He continued such researches at intervals until quite recently, his last paper, on a bone of a pelican from the Yorkshire peat, appearing in *The Naturalist* of June 1928. It may be added that Newton rarely dealt with controversial matters, but his account of a human skull found in a Pleistocene deposit at Galley Hill, Kent, published by the Geological Society in 1895, began a long discussion which still continues.

Of all Newton's contributions to vertebrate palæontology, however, the most fundamental were three memoirs on fossil reptiles published in the *Philosophical Transactions* of the Royal Society. In 1887, by the delicate preparation of the skull of a pterodactyl from the Upper Lias of Whitby, he gave the first satisfactory description of the brain of a flying reptile. In 1893 and 1894, by taking gutta-percha casts from the hollows left by the decay of bones which were once buried in the Permo-Triassic sandstones of Elgin, Scotland, he utilised in an astonishing manner a most unpromising collection of the remains of various land reptiles, and revealed several skulls and other parts of the skeleton of genera closely related to some previously found only in the Karroo formation of South Africa and in corresponding rocks in India.

Although occupied so much with research, Newton still found time to take an active part in the work of scientific societies in London. For several periods he was a member of council of the Geological and Palæontographical Societies and of the Geologists' Association. He was also a member of the publication and finance committees of the Zoological Society. He was president of the Geologists' Association in 1896–98, and president of the Palæontographical Society from 1921 to 1928. He was elected a fellow of the Royal Society in 1893, and received the Lyell Medal from the Geological Society in the same year. To his scientific worth was added a charming personality, unassuming and kindly, which leaves happy memories with all who had the good fortune to be associated with him.

A. S. W.

SIR GEORGE DANCER THANE.

SIR GEORGE THANE died on Jan. 14 within four months of the eightieth anniversary of his birth. He was associated with University College, London, as student, demonstrator, professor of anatomy, and emeritus professor for more than sixty-three years. When only twenty years of age, and not yet qualified to practise medicine, he was chosen by Prof. George Viner Ellis for the office of demonstrator of anatomy, and seven years later, on Ellis's retirement, Thane was appointed to succeed him in the professorship, which he occupied for forty-two years.

The mere enumeration of the forty-nine years which Thane devoted to the teaching of anatomy at University College represents only one aspect of the great services he rendered. Nor did the work or research in, and teaching of, anatomy form the major element in his whole-hearted devotion to University College and to anatomy. His greatest achievement was his cultivation of a personal knowledge of the students who worked under him, and of a sincere interest in their welfare, which he maintained throughout their subsequent careers. He became their lifelong friend. Thus his genial personality, and in particular his passion for accuracy in observation and restraint in expressing what he saw, influenced the lives of thousands of medical men and women. This played a large part in building up the solid reputation of medical education in London.

Thane had a very wide and exact knowledge of anatomical literature. Among his contemporaries he was personally acquainted not merely with their published works but also with the men themselves in their laboratories and their social life. By his own investigations he acquired the critical instrument for assessing the value of other anatomists' work, and his judgment and power of lucid expression made his own writings a sober and wonderfully accurate picture of the state of anatomical knowledge.

Like his predecessors in the chair of anatomy at University College—the men who created "Quain's Anatomy" and made it the standard text-book which was adopted as a model throughout the world—he put his best work into this book, rather than into the scientific journals. His contributions to the 9th and 10th editions of "Quain's Anatomy" not merely maintained the high qualities and reputation of the work, but also extended its range and precision, and made it the most reliable and adequate text-book on the subject that at the time had been produced.

Thane was one of the founders of the Anatomical Society of Great Britain and Ireland, and years afterward when he became its president the respect in which he was held abroad was shown by an exceptionally large attendance of distinguished foreign anatomists. Thane was an active member of the German and French anatomical societies, and took a delight in attending their meetings, as well as the international anatomical congresses.

During his years of service as inspector of experiments on living animals, Thane took a keen interest in acquiring a personal knowledge of physiologists and in facilitating their work. He was an honorary D.Sc. of Dublin and LL.D. of Edinburgh, and on his retirement from the active work of his professorship a knighthood was conferred upon him in recognition of his public service. By his death his former students have lost a wise and kindly friend and the science of anatomy a teacher who unobtrusively did a vast amount of work to establish the foundations of an exact knowledge of the human body.

News and Views.

DR. CARL STØRMER, professor of pure mathematics in the University of Oslo, Norway, is shortly visiting Great Britain—for the first time—primarily at the invitation of the University of London. He is known in scientific circles throughout the world as the leading authority on the aurora polaris. His work on this subject has covered a very wide range. On the side of theory he has developed mathematically the ideas first propounded by Kron Birkeland as a result of laboratory experiments on the projection of cathode rays towards a magnetised sphere representing the earth. In a long series of mathematical papers, Størmer has investigated the trajectories of electric corpuscles projected from the sun towards the earth and deflected by the earth's magnetic field; he has shown that numerous observed features of the aurora can thus receive a natural explanation. Many problems connected with auroræ and the associated phenomena of magnetic storms still remain unsolved, but it seems certain that much of Størmer's work will form an integral part of the complete theory when this is arrived at finally.

FURTHER, Størmer is a great pioneer observer of auroræ; he was the first to develop a practical and accurate method of determining the height and situation of auroræ in the atmosphere. Simultaneous photographs of the auroræ are taken, from two or more places connected by telephone, and on plates that also show some of the background of stars, which serve as reference-points for direction. The telephonic facilities which he receives in this work from the national authorities in Norway, when an aurora is in progress, afford a remarkable instance of State co-operation in purely scientific research. Among his most important recent discoveries is the fact that the exceptionally high auroral rays, rising to heights of 700 km. or 800 km., are situated in the sunlit atmosphere, though they are viewed after sunset at the place of observation; he has also recently directed attention to the long-period radio echoes, which he attributes to reflection by streams of solar corpuscles far from the earth. Prof. Størmer is lecturing in London on Feb. 28, Mar. 5 and 7, mainly on the theory of the aurora, but also on his observations, which he will illustrate with many of his beautiful auroral photographs. He is also visiting the Universities of Oxford, Cambridge, Manchester, Edinburgh, and Aberdeen. It is to be hoped that his visit, particularly to Scotland, will arouse new interest in the observation of auroræ by skilled amateur observers; an international committee, of which he is chairman, has prepared an auroral atlas, and various alternative plans, for use in such observations.

THE British Industries Fair, 1930, was opened on Feb. 17, and will remain open until Feb. 28. The London section is being held this year at Olympia instead of, as formerly, at the White City. The Birmingham section is held, as before, at Castle Bromwich. At London the exhibits cover a wide and diversified range of British manufacture, including—to take only a few examples at random—cutlery, jewellery, glassware, paper, leather, toys, scientific and optical instruments, wireless apparatus, musical instruments, chemicals, and textiles. The exhibits at Birmingham may be described as heavier, since they relate mainly to the iron and metal trades, power (lighting, heating, cooking, and ventilating plant), engineering, railway plant, mining plant, and brewing. While the London section is organised by the Department of Overseas Trade, the Birmingham section is organised by the Chamber of Commerce under the auspices and with the support of the Department of Overseas Trade. It should be noticed that only British manufacturing firms are permitted to exhibit, and that no exhibitor may exhibit articles other than those of his own manufacture. Since the Fair is organised for business and not for show, trade buyers are admitted to the Fair free between 10 A.M. and 8 P.M. on each day. The public are, however, admitted daily on payment between 4 P.M. and 8 P.M., except on Saturday, Feb. 22, when the hours will be 1 P.M. to 8 P.M.

IN order to further the business purpose of the Fair, the Department of Overseas Trade has installed a special office in the Fair where visitors and exhibitors can obtain commercial information on such subjects as tariffs, transport, etc. In addition, there is in each section of the Fair an officer of the Department who is prepared to give information as to conditions in overseas markets, sources of supply, the appointment of suitable agents, and other matters relating to export trade. Besides these facilities the services of interpreters are available free of charge. The British Industries Fair has grown steadily from strength to strength. It is perhaps the one Exhibition which offers, above all others, the greatest opportunity of seeing the latest developments in British manufactures gathered together under one roof—or, rather, under two roofs, one in London and the other in Birmingham. The importance of the Fair at this critical period in the manufacturing industry of Great Britain can scarcely be exaggerated.

AN interesting experiment has been inaugurated in Lanarkshire this week as a result of which ten thousand school children are receiving three-quarters of a pint of milk daily until July. The scheme is the most ambitious venture in the realms of physiological research ever attempted in Great Britain. Five thousand children are receiving a ration of raw milk, five thousand are receiving pasteurised milk, and ten thousand will be observed as control subjects. All are being weighed periodically, and elaborate data regarding increase in stature, progress in health, etc., will be compiled at the close of the experiment. The enormous number of children involved in the test will ensure that results will be of so general a character that physiologists will be able to justify the broadest conclusions from them. It is expected by leading Scottish agriculturists that the consumption of milk in Scotland will be greatly increased as a result of the

experiment. At present the consumption per head in Scotland is one of the smallest in the world, and an increase would raise the standard of public health in the country.

FROM the medical point of view, this experiment in Lanarkshire is equally interesting. All milk used is Grade A, guaranteed from herds free from tuberculosis. At present almost three thousand cases of tuberculosis are reported every year in Scotland, and if this scheme assists by showing to the people the benefits derived from using the best milk available, then it will to a great extent have justified itself. All the arrangements are in the hands of the Lanarkshire Education Authority and its staff of doctors, nurses, and teachers. No administrative charges will require to be met, and all the money will be available to provide the milk. The cost of the scheme is in the neighbourhood of £9000, of which £5000 has been granted by the Empire Marketing Board and £2000 by the Distress in Mining Areas (Scotland) Fund. The remaining £2000 will be provided from a source not yet known. The experiment was inaugurated at a meeting in Hamilton Academy on Saturday last, when an address was given by Mr. Thomas Johnston, Under-Secretary of State for Scotland. Several Lanarkshire Members of Parliament also took part, and representatives were present from the West of Scotland Agricultural College, the Hannah Dairy Research Institute, the Scottish Milk Agency, Ltd., and the Farmers' Union. Nine hundred gallons of milk are being supplied daily by the Scottish Milk Agency, Ltd.

THE composition of the new Economic Advisory Council was announced by the Prime Minister in the House of Commons on Feb. 12. Fifteen non-Ministerial members have been selected to serve in an advisory capacity, and of these, five represent what may be called the academic side, namely, Mr. G. D. H. Cole, Sir Daniel Hall, Sir William Hardy, Mr. J. M. Keynes, and Mr. R. H. Tawney. Seven of the members have been drawn from industry and finance, including Sir Arthur Balfour (chairman of the Committee on Industry and Trade), Sir John Cadman, Mr. Ernest Debenham, Sir Andrew Duncan, Sir Alfred Lewis, Sir William M'Lintock, and Sir Josiah Stamp. Labour organisations are represented by Mr. Ernest Bevin and Mr. W. M. Citrine, while Mr. W. R. Blair is representative of the co-operative movement. The Ministerial members of the Council, as already announced in the Treasury Minute dated Jan. 27, are the Prime Minister (chairman), the Chancellor of the Exchequer, the Lord Privy Seal, the President of the Board of Trade, and the Minister of Agriculture. Other Ministers may from time to time be invited by the Prime Minister to participate in the deliberations of the Council, and it has been stated that a number of distinguished industrialists and economists have consented to assist on specific points. A whole-time staff has also been appointed, consisting of Mr. Thomas Jones (secretary), Mr. H. D. Henderson, Mr. A. F. Hemming, Mr. H. V. Hodson, and Mr. Colin G. Clark.

THE appointment of the Economic Advisory Council has recently been the subject of correspondence in the columns of the *Times*. In the issue dated Feb. 13, 'Econax' pointed out that a vast amount of economic information is already provided by various Government Departments, such as the Board of Trade, the Ministry of Labour, the Ministry of Agriculture and Fisheries, and the Ministry of Transport. On the establishment of the Board of Trade there is a chief economic adviser to H.M. Government who is able to draw upon all the resources of the Board. Empire problems of an economic character are already covered by the Imperial Economic Committee, the Imperial Shipping Committee, and the Empire Marketing Board. In view of this very exhaustive machinery for the collection of economic data and for advisory purposes, 'Econax' argued that the setting up of an Economic Advisory Council is an innovation which appears to merit more detailed examination by Parliament than it has hitherto received. Commenting on this letter, the *Times* stressed the existence of a network of departmental and other bodies created for the very needs which an Economic Advisory Council appears to be designed to supply. "Why should the Civil Research Committee or the Melchett-Turner Conference be superseded as co-ordinating bodies", or if they were not to be superseded, "How was the new Council to supplement their work"? In a reply to 'Econax', Sir William Beveridge claims that some body is necessary to co-ordinate the various economic activities of different departments so that the economic life of the country may be seen as a whole by the Government, although he admits that only experience can show if the new machinery will accomplish this object.

PROF. JULIAN HUXLEY, speaking on the aims of school biology, in an address delivered on Feb. 8 to the School Nature Study Union, urged the cultural value of the subject, and deprecated unnecessary technicality in the teaching. He pointed out the wide applications of biological principles to purely human, political questions, such as population, eugenics, social and personal hygiene, and so on, and their consequent national importance; and submitted that this consideration justifies the employment of biology as a 'bridge' by which the humanities should be linked with natural science; the easiest bridge being afforded by the history of biology. In the course of the address it was shown that many of the facts and principles of chemistry and physics, including mechanics, can be approached and elucidated from the biological side; to mention but a few examples, respiration naturally leads to the chemistry of combustion; nutrition and metabolism to sources, expenditure, and conservation of energy, and also to the theory of solution and osmosis; skeletal structures to the mechanics of levers. In actual practice, however, the order of teaching is almost always reversed, the chemical and physical processes exhibited by living organisms being approached through previous study of inanimate objects. In view of the fact that Nature study, chiefly of a biological kind, is usually the first stage in science teaching, it is more rational to expand on this foundation in every possible direction so as to embrace the other subjects as

the educational edifice is enlarged, rather than to create a gap, and start the second stage, where definite scientific principles are properly introduced, *de novo* and disconnected from its predecessor.

FOR his presidential address to the Optical Society on Feb. 13, Mr. F. Twyman took as his subject "Optics in Radio Transmission and Other Fresh Fields". Optics, which originally meant the science treating of light and the phenomena of vision, has, said Mr. Twyman, by general consent come to include the phenomena of infra-red and ultra-violet radiation. The time is now ripe for a further extension to include other radiations, such as those used in radio transmission and the X-rays. Not only does the propagation of all these radiations follow the same laws, but also the manifestations of them which have become of interest in recent years are often of a nature long familiar to those dealing with optics. Furthermore, some of the recent developments have resulted from the application of minds trained in optics to consideration of these other radiations. Illustrations include the polarisation and interference of radio waves, the latter phenomenon enabling the height of the Heaviside layer to be determined; while the use of the notions associated with the diffraction grating have resulted in novel suggestions for radio transmission. The 'optical' phenomena of X-rays include the formation of characteristic spectra of the elements by the use of a crystal in a manner closely analogous to that in which the well-known optical spectra are produced by means of a diffraction grating. The production of Aston's mass spectra, in which atoms of varying mass are distributed, and photographically register their position in a 'spectrogram', was also dealt with.

IN a leading article in the *Engineer* for Feb. 14, reference is made to the appointment of Sir Harold Hartley as vice-president of the London, Midland and Scottish Railway Co. (NATURE, Feb. 8, p. 213), and to the subject of scientific research on the railways. An advisory council of eminent men of science is to be set up under the chairmanship of Sir Harold, and our contemporary asks, among other things, whether the investigations made are to be solely for the benefit of the L. M. and S. R., or whether the results are to be made available for the other companies. Collective experiment and collective testing have gone further than collective research, and the question is of greater moment now, as a committee is inquiring into the question of the Department of Scientific and Industrial Research establishing a locomotive experimental testing station. There are many matters, both technical and economic, connected with the railways that will pay for careful inquiry, and one of the things to be guarded against is unnecessary overlapping and duplication. It is pointed out that the capital invested in the railways of Great Britain amounts to 1211 million pounds; the receipts to 218 millions a year, and the expenditure to 177 millions, and that no fewer than 700,000 persons are employed on them. To emphasise the value of research, the *Engineer* recalls the figures given by Mr. Garcke at a recent luncheon of the British Electrical and Allied Industries Research Association. Research work on insulating oils, he said, has cost £8500 but is saving £100,000 a year; researches on the heating of buried cables has cost £18,500, but has saved the industry at least half a million and added something like four millions to the duration value of the cables.

THE movement for establishing scientific and industrial museums in important provincial centres is one worthy of support from all those who have it in their power to further such projects, and it is with interest we learn that the North-East Coast Institution of Engineers and Shipbuilders is taking active measures for the founding of an engineering museum in Newcastle. In a memorandum, the Council of the Institution has given its reasons for so doing and it has now requested the Lord Mayor of Newcastle-on-Tyne to appoint a fully representative committee for the purpose of establishing the proposed museum. As the metropolis of one of the largest industrial districts in Great Britain, Newcastle has cause to be proud of its long list of distinguished shipbuilders and engineers, and with the assistance of the great firms in the district there should be no difficulty in immediately forming a nucleus for such an institution. Stephenson, Hawthorn, Armstrong, Swan, Palmer, Tweddell, Noble, and Parsons are but a few of those who, during the past hundred years, have contributed to engineering progress, and their names are written large across the annals of the Tyne. Stephenson's first locomotives conveyed coal to the river. Stephenson's shop in Forth Street was the first locomotive factory in the world; the *John Bowes*, the forerunner of our ocean tramps, was launched on the Tyne; hydraulic cranes and hydraulic tools were introduced there by Armstrong and Tweddell; the turbo-generator and the marine steam turbine were brought to perfection there, while in the Tyne-built vessels the *Turbinia* and *Mauretania* the river gave birth to two of the most historic ships that ever floated.

WHILE engineering and shipbuilding occupy a foremost place among the industries of the north of England, that of coal mining is equally important and its history goes back to the thirteenth century. The development of coal mining and transport would alone form an interesting section for an industrial museum. But Newcastle is the home of many industries to which science has given birth, as it is also the cultural centre of Northumberland and Durham, which have a population of more than 2,000,000. The museum thus should be not only a place for the preservation of memorials of the past but also an institution with definite educational aims. We may perhaps be permitted to express the hope that the exhibits will be chosen with the greatest care; that each section will be made to illustrate in orderly sequence the outstanding improvements of the subject and that it will be borne in mind that a few objects well displayed are generally of greater use to the visitor than more extensive collections. It should also be possible, in such a museum, to secure for temporary loan, collections of a similar character to those distributed to local museums by the Victoria and Albert Museum,

and an essential part of the work of the museum should be the provision of occasional lectures both of an elementary character suitable for school classes and of a most advanced nature for the general public. In the development of a local technological museum such as is evidently contemplated, the committee will have many problems to solve; in the museums in London, Munich, and elsewhere, the committee will have much experience to draw on, but it will have at the same time the opportunity of founding a museum which might well become a model for others elsewhere.

THE interest of Ur seems inexhaustible. Each report from Mr. Woolley now seems to open up fresh vistas in the development of the early civilisation of Mesopotamia. In the present season, the work of the month of December, which is described in the *Times* of Feb. 11, has revealed material which once more takes the time-series back to a date far beyond the hopes of the excavator in this area a few years ago. Continuing excavation in the cemetery area, the expedition, among other discoveries, has found a man's burial with the remains of a wig decorated with gold ear-rings and a gold frontlet, thus confirming a suspicion that the Sumerian nobleman was clean-shaven and wore a wig on state occasions. The chief interest of the excavation in this area has now, however, been diverted to the huge rubbish mounds in which the graves were dug. Here eight well-defined strata have been found. Over the graves is the stratum of the First Dynasty, about 3100 B.C.; below this a layer with slightly earlier seals; then a deep zone in which are nearly all the graves. Below the graves are five further layers containing tablets and seal-impressions. It is interesting to notice that in the successive strata a gradual development from naturalism to convention in art is noticeable. Intricate linear designs such as are not known in any later period are sometimes combined with signs from the script. In some cases half the characters are new; in others they are interrupted by pictures, birds, bulls' heads, and the like, which suggest a transition stage between hieroglyphic and linear writing.

THE whole series of new finds at Ur is unparalleled in Mesopotamia, so much so that it is suggested a foreign origin might be attributed if it were not for the clearly Sumerian character of other objects. Bulls' hoofs in copper exactly resemble the copper sculptures of the tombs, though more than 20 feet lower down. The stratification of the cemetery is to be closely related with that of the town site, where a second excavation is in progress. Here houses are found built one above the ruins of another. In a depth of 29 feet, eight separate buildings have been unearthed, the fourth of these from the top already older than the royal graves, and the sixth contemporary with the cemetery stratum which produced the bulls' feet and the remarkable seal impressions. In the eighth are splendid examples of the pottery painted in three colours hitherto reported only from Jemdet Nasr, near Kish, and below begin to appear the black and green sherds of the al 'Ubaid type. In this same stratum was found the figure of a wild boar in steatite, the oldest piece of sculpture from Ur.

A FILM phonograph which plays continuously for two hours has now been invented by Dr. C. W. Hewlett, the engineer to the General Electric Co. of America. A reel of film four hundred feet long but small enough to fit into a coat pocket can reproduce a complete play or opera which otherwise would require at least fifteen twelve-inch disc records. To obtain this result, Dr. Hewlett utilises one of the methods used for recording sounds when making 'talkie' films. A jagged line photographed on the edge of the film represents the sound. Light coming from a narrow slit passes through the film into a photoelectric tube. As the teeth of the jagged lines pass by the slit the amount of light reaching the tube is varied and this varies the magnitude of the electric current. This current after amplification actuates a loud speaker and a clear reproduction of the original sound is made. According to the *Science News-Letter* of Jan. 25, this 'child of the talkies' heralds the home entertainer of the future. The film has no sequence of photographs and contains only sound records. A continuous loop of film is used, unwinding from the inside as it winds up on the outside. With the present model, there is space for nine separate sound tracks, but this will doubtless be increased. When a track ends, the machine shifts automatically to the next in a fraction of a second, so that there is no practical interruption of the sound. The film runs at a speed of forty-five feet per minute, which is about half the speed at which ordinary talking motion picture films run. So far, no plans have been announced for the commercial development of the film phonograph.

INTEREST has been taken in Great Britain in gliding since 1896, when Pilcher and Weiss, to mention only two of the pioneers, made their successful experiments. In Germany, because the Peace Treaty made the use of aircraft difficult or impossible for the private owner, the glider was developed scientifically, with the result that an entirely new type of aircraft, the 'sail-plane', was evolved. The glider will fly in a strong upward current of air such as is found on the slopes of hills, but it is not capable of extending the flight beyond the limits of this current of air. The 'sail-plane', although it requires a moderate upward current of air to start its flight, is able to make use of the very slight upward trend of the air which supports cumulus clouds, the force of gusts of wind, and line squalls, as well as those very slight currents of air that are due to the changes in the reflection of the sun's rays by variations in the surface of the ground. The ability of the 'sail-plane' to soar in the same manner as a bird opens fresh possibilities in the field of aeronautics. In Germany the Rhön-Rossitten-Gesellschaft, and in the United States the National Glider Association Inc., have drawn up regulations to ensure the adequate strength and safety of gliders and 'sail-planes'. They issue certificates of airworthiness, approve gliding grounds, and license pilots and instructors for these engineless aircraft. In Great Britain the British Gliding Association, 44A Dover Street, London, W.1, will do the same work; full regulations will be announced at the inaugural

meeting to be held on Mar. 27. Lord Wakefield is presenting a cup to the Association, which will be awarded for the most meritorious performance.

AT the meeting of the Linnean Society of London on Feb. 6, the president, Sir Sidney F. Harmer, exhibited a pair of shoe-laces, and commented on their zoological interest as illustrating a remarkable characteristic of the Delphinapteridæ. This family, the only recent species of which are the white whale (*Delphinapterus leucas*) and the narwhal (*Monodon monoceros*), both Arctic animals, differs from other Cetacea in the structure of the skin. The epidermis in this order is normally in immediate contact with the blubber, a thick layer of dermis containing a great quantity of oil or fat. In the Delphinapteridæ the epidermis is separated from the blubber by a superficial layer of dermis, which by suitable treatment becomes leather of excellent quality, generally known as 'porpoise leather'. The laces exhibited had more elasticity than ordinary leather, and probably were actual products of *D. leucas*, as indicated by the designation, 'genuine white whale buckle laces', under which they are being sold. The white whale has been captured in limited numbers, during recent years, chiefly by vessels operating from Norway.

PROF. B. BLACKLOCK, of the Liverpool School of Tropical Medicine, delivered a Chadwick Public Lecture on Feb. 13, taking as his subject "Health in West Africa". The health problems of the British West African colonies are of growing importance. The increase of annual West African trade, from sixteen million pounds in 1907 to sixty million pounds in 1927, has resulted in a large influx of white residents. The fall in the death and invaliding rate among Government officials since the beginning of the century has been remarkable. For the period 1881–97, the Gold Coast officials had a death-rate of more than 75 per 1000 per annum, and Nigerian officials a death-rate of more than 53 per 1000 per annum; for 1928 the death-rate for officials over the whole of the West African colonies, including Gambia, Sierra Leone, the Gold Coast, and Nigeria, was only 6·7 per 1000. It would be useful to have similar figures from commercial firms with employees in West Africa. The marked improvement in the health of Government officials reflects great credit on the medical and sanitary administration. But it was obtained only by the co-operation of the total white residents; the European in West African coastal regions can only keep free from disease by meticulous care of himself. Even when free from actual sickness, the average European does not feel fit in the West African low-lying country; better housing and more suitable recreation, in which the governments might take an official interest, will help to eliminate part of this disability. Prof. Blacklock then discussed the problem of trying to bring the housing, diet, and general sanitation of the native up to a reasonable standard. In West Africa there are under British rule some 25 million natives, and the vast majority of them are remote from medical aid. Good work has been done in Sierra Leone in the form of a survey of disease and the construction of good motor roads, but a very great deal can also be done by the education of the native, in his own tongue, in elementary hygiene.

THE major contribution in the January number of the *Natural History Magazine* of the British Museum (Natural History) is Dr. Rendle's popular account of some of the impressions made upon a botanist by his recent tour with the British Association in South Africa. Many naturalists will read with interest also R. I. Pocock's unravelling of the identity of the 'Nandi bear', an unidentified predatory animal, held in horror by the natives of East Africa (according to themselves), which so far has eluded the white sportsman. The skin and skull at last received as the authentic relics of this creature turn out to be, as regards the skin a spotted hyena, and as regards the skull a leopard. The entire story of this fabulous beast and the solution prove again the need for the closest and most critical scrutiny of natural history information derived from native sources.

THE Royal Air Force is to be congratulated on the distinct success achieved with the first issue of its new journal, the *Royal Air Force Quarterly*. The magazine has for its object the promotion and advancement of aeronautics, both in and out of the service, and if the standard of future issues can be kept as high as that attained in the first, so far as quality at any rate is concerned, its success is assured. The articles deal, among others, with such diverse questions as operations in the Near and Far East, co-operation in the Army and Navy Air Force, air strategy, analysis of leadership, preparation for the Staff College, Trans-Jordania, wind structure, metal military aircraft, and high speed flight—clearly a very broad field of view. The journal is illustrated by a series of exquisitely produced and valuable photographs and reproductions which reflect great credit on the compilers. It is to be hoped that an equally high standard of finish will be maintained in future issues.

THE Medical Research Council has appointed Air Vice-Marshal David Munro, on his retirement, as Director of Medical Services, Royal Air Force, to be Secretary of the Industrial Health Research Board in succession to Mr. D. R. Wilson, lately appointed Deputy Chief Inspector of Factories at the Home Office. The appointment will take effect on Mar. 1.

THE following officers and new members of Council of the Royal Astronomical Society were elected at the annual general meeting of the Society on Feb. 14: *President:* Dr. A. C. D. Crommelin; *Treasurer:* Mr. J. H. Reynolds; *Secretaries:* Prof. H. Dingle and Dr. W. M. Smart; *Foreign Secretary:* Prof. H. H. Turner; *New Members of Council:* Dr. J. A. Carroll, Dr. J. Jackson, Mr. B. M. Peek, and Prof. F. J. M. Stratton.

SIR WILLIAM BRAGG, Fullerian professor of chemistry in the Royal Institution and director of the Davy Faraday Research Laboratory, has been awarded the Franklin Medal by the Board of Managers of the Franklin Institute, Philadelphia, "In recognition of a life-work in the study of X-rays and radio-

activity, in the course of which he made fundamental contributions to that realm of physics, of his development of a method of determining molecular and crystal structure by the reflection of X-rays and of his fruitful guidance of the Davy Faraday Research Laboratory and the Royal Institution of Great Britain".

THE High Voltage Research Laboratory of the Metropolitan-Vickers Electrical Co., Ltd., at Trafford Park, Manchester, will be opened by Sir Ernest Rutherford, President of the Royal Society, on Friday, Feb. 28. In recent years the Company has been developing building accommodation, equipment, and staff at Trafford Park to deal satisfactorily with its requirements for investigational work in the whole field of high voltage phenomena. The nature of the opening function on Feb. 28 will be a short formal ceremony by Sir Ernest Rutherford, followed by some special demonstrations, and an inspection and examination of the detailed equipment in the high voltage laboratory itself, and also in the other laboratories of the Company, covering a wide field of physics, metallurgy, and electrotechnics generally.

IN consequence of inquiries respecting psittacosis or parrot fever, the Ministry of Health has issued a memorandum on the subject which should prove useful to medical officers of health and others (Memo. 151/Med. London: H.M. Stationery Office, price 1*d*.). The characteristics of the disease and the circumstances of its occurrence are described and precautionary measures suggested, and should suspected cases occur the data of importance for investigation are detailed.

A NEW (the third) edition of "Studies concerning the Handling of Milk" (*Research Monograph* No. 1) has been issued by, and may be obtained from, the Ministry of Agriculture and Fisheries, Whitehall Place, S.W.1 (1s. net post free). It contains much valuable and detailed information on the factors concerned in the production of clean and wholesome milk.

MESSRS. W. Dawson and Sons, Ltd., Cannon House, Pilgrim Street, E.C.4, have just issued a catalogue (N.S. No. 2) of scientific journals, transactions of learned societies, and books relating to travel, topography, ethnology, anthropology, statistics, etc. The list is noteworthy for the many sets and long runs of scientific serials and transactions offered for sale—the longest to reach us recently. It should be seen by all who wish to fill up gaps in their libraries.

WITH the publication of the January number, the *Collection of Czechoslovak Chemical Communications* begins a second volume of this new journal. The first volume (reference to articles in which have appeared in NATURE) contained 690 pages. In the January number there are papers on adsorption phenomena at a mercury dropping electrode and on the preparation of new sugars in the series of methylpentoses. There is also a bibliography of Czechoslovak chemical publications which have appeared during 1929 in various journals.

THE first number has reached us of the *Journal of Dairy Research*, a new periodical published on behalf of the Dairy Research Committee of the Empire Marketing Board and edited by its chairman, Prof. Stenhouse Williams. The journal is designed to include reviews by specialists of existing knowledge in different aspects of dairying, original contributions to dairy science, and reviews and abstracts of current literature, and is published by the Cambridge University Press in half-yearly parts of about 100 pages at the subscription price of 15*s*. per volume of two parts. The present number contains a foreword by Lord Passfield, a review monograph by E. T. Halnan on feeding standards for dairy cows, four original articles, and abstracts and reviews of current literature.

MONTHLY summaries of current scientific and technical literature dealing with water supplies, sewage, trade wastes, river pollution and relevant subjects have been prepared during the past two years by the Department of Scientific and Industrial Research. These summaries were compiled primarily for the use of the Water Pollution Research Board of the Department, and a limited number of copies were circulated in neostyled form. There is evidence that these summaries would be of value to a wider public, and it has been decided, therefore, to issue a monthly publication containing selected abstracts, the first number of which has just been issued as *Summary of Current Literature*, Vol. 3, No. 1, January 1930. Abstracts Nos. 1-119. Water Pollution Research: Department of Scientific and Industrial Research (London: H.M. Stationery Office. 1*s*. 3*d*. net. Annual subs. 15*s*. net).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior lecturer in mathematics at the Royal Military Academy, Woolwich—The Commandant, Royal Military Academy, Woolwich, S.E.18 (Feb. 28). A lecturer-in-charge, with good degree in physics and chemistry, and a lecturer in applied science, at the Abertillery Mining and Technical Institute—D. Brynmor Morgan, County Hall, Newport, Mon. (Feb. 28). An assistant lecturer in metallurgy in the University of Birmingham—The Secretary, The University, Birmingham (Mar. 3). An assistant lecturer and demonstrator in anatomy in the Faculty of Medicine of the University of Birmingham—The Secretary, The University, Birmingham (Mar. 10). A keeper of the Natural History Division of the National Museum, Dublin, and two assistant keepers in the Art and Industrial Division, one assistant in the Irish Antiquities Division, and one assistant in the Natural History Division of the Museum—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (Mar. 10). A senior and a junior research assistant under the Animal Diseases Research Association — The Secretary, Animal Diseases Research Association, Moredun Institute, Gilmerton, Edinburgh (Mar. 31). A temporary part-time mathematics master at Willesden Polytechnic — The Principal, Willesden Polytechnic, Priory Park Road, Kilburn, N.W.6.

Research Items.

Birth- and Death-rates.—In an article by Dr. C. Tietze in the *Eugenics Review* for January last, interesting data regarding the birth- and death-rates in Germany are given, as well as comparable statistics for England and France. Since 1925 the birth-rate of England has been less than that of Germany or France. England and Germany were nearly equal in 1920, at 25·5 and 25·8 respectively. The French rate was then 21·3, but afterwards fell to 18·2 (1928), while Germany was 18·6 and England 16·7. But considering the number of child-bearing women, the French birth-rate is 10 per cent higher than the German. All these diminishing rates are evidently due to wider use of contraceptives and increased abortions. Death-rates have similarly declined from 26 in Germany and 21·4 in England in the period 1841–45, to 11·6 and 11·7 respectively in 1928. The net reproduction rate is now below zero in western Europe, but of the three countries considered, it is lowest of all in England and highest in France. Predicting from such figures, the population of both England and Germany will probably begin to decline in the period 1940–50.

Boredom in Industry.—Report No. 56 of the Industrial Health Research Board is concerned with an investigation into the effects of monotony in work, by Wyatt, Fraser, and Stock. Output curves from workers in several industrial processes of a repetitive kind were obtained and these were related to subjective experiences with regard to interest and boredom It is clear that there is considerable individual variation in susceptibility to boredom, although there were very few of the subjects who were seldom or never bored. The more intelligent workers were more liable to boredom on repetitive work than the others. The effect of boredom was to reduce the rate of work and to increase the variability. Boredom was also related to the degree of mechanisation; it was less likely to occur when, (*a*) the work was entirely automatic so that the thoughts could wander to other things, or (*b*) when attention could be entirely concentrated on the work. The effects of different methods of remuneration, whether piece rates or time rates, the influence of the group and other complicating factors are also considered. The report is described as of a preliminary nature, but the problems raised are so important for industry that it is well that they should be formulated and studied scientifically.

Breeding Grounds of Blue Goose.—Although the blue goose (*Chen cærulescens*) is a migrant which is familiar in winter in the United States, where it then inhabits the estuary of the Mississippi River, until now its breeding ground in the Arctic has never been found. A great search for this mysterious summer haunt, which was generally thought to be in the northern regions of Canada, has finally been crowned with success. The discoverer, J. Dewey Soper, in his long drawn-out exploration, spent nearly three years in the task and covered about 30,300 miles in all, of which 4000 miles were by dog team and small boat in and about Baffin Island (*Canadian Field Naturalist*, January, p. 1; 1930). In June the birds began to enter the breeding area, by June 8 and 9 thousands appeared, but the heaviest influx, which included, besides snow geese and blue geese, also brent and Hutchin's geese, occurred in the middle of the month. Even then the nesting ground was difficult to locate, but on June 26 a group of ten nests, eight of them those of blue geese, was found on the tundra near Foxe basin in latitude 65° 30′ N. An account is given of the nest and the characters which distinguish the downy young of the blue and lesser snow geese.

Growth in Insects.—The observations upon the growth and development of some ten species of dragonflies (Odonata), made by Philip P. Calvert, have some interesting general results (*Proc. Amer. Phil. Soc.*, vol. 68, p. 227; 1929). The number of moults was found to vary, and therefore moults are not absolute indicators of biological age. Nor do they show that rigidity of growth which has been expressed by the Brooke-Przibram ratio of 1·25 or 1·26. Ten species of dragonflies were reared from egg to adult, and the ratio of each instar recorded. Nine of the species gave a more rapid rate of growth than the ratio demanded, and the ratios from instar to instar were very inconstant. The growth factor varies in an irregular way from instar to instar in dragonfly larvæ and in other arthropods, and these variations are not correlated with changes in the character of the food, facts which detract from the value of Brody's comparison of growth in warm-blooded and cold-blooded animals. Adults of insects with complete metamorphosis are usually smaller than their corresponding larval stages, a character exhibited by a few non-arthropods. But in the great majority of non-insectan animals the relationship resembles that in insects with incomplete metamorphosis, where the adults usually exceed in length the larvæ from which they have developed.

Arctic Diatoms.—Dr. D. Vito Zanon, S.C., in a paper entitled "Diatomee della Baia del Re (Swalbard)" (*Memorie della Pont. Accademia delle Scienze Nuovi Lincei*, Serie 2, Volume 12, 1929), describes a number of diatoms from King's Bay on the west coast of Spitsbergen. These were collected by Dr. P. Gianfranceshi during the polar expedition undertaken by General Nobile, and consist mainly of littoral and bottom forms, although a few planktonic species are recorded. A full list of arctic diatoms is given and a large number of these were found in the material investigated, besides other forms which are new for that region, several new varieties and one new species, *Denticula nobilei*, which is named after General Nobile. Among the planktonic species are *Rhizosolenia hebetata* and four species of *Chætoceros* which are new Spitsbergen records.

Striated Muscle in Liver of Spider.—S. Maziarski (*Bull. Internat. Acad. Polonaise Sci.*, Series B, No. 3, 6BII; 1929) describes the occurrence in the liver of spiders (*Tegenaria*, *Araneus*, *Epeira*) of numerous contractile elements in the form of branched transversely striated muscle cells. These are disposed on the external face of the basal membrane of the acini of the gland and form a network either by intercrossing or by direct anastomosis of the prolongations of the cells. In their form and position these cells correspond with the branched cells which have long been known—under the name of the basket of Boll—in the salivary glands of vertebrates. In the latter the branched cells are smooth and are situated on the internal face of the basement membrane. The presence in the liver of spiders of cells the muscular nature of which is beyond doubt, homologous with those in the salivary glands of vertebrates, confirms the view that the basket of Boll is contractile. The liver of spiders is a diverticulum of the intestine and its glandular follicles, richly branched and anastomosed, open by four or five ducts into the gut. The considerable development of

muscular tissue in the liver is, in the author's view, correlated with the double function of this organ. The follicles are lined with two kinds of cells; some are glandular and produce digestive ferments and the other cells absorb the digested material. The muscular tissue is responsible for the transport of material from follicle to follicle.

Wild Cacao.—Two interesting photographs by Prof. G. Stahel, director of the Surinam Agricultural Experiment Station are reproduced in *Kew Bulletin*, No. 1, 1930, which show what is thought to be indigenous, wild cacao growing along the valley of the Mamaboen Kreek, where it is many miles away from any original plantations or even from any Indian village. The plants in this valley were extraordinarily uniform in character and could definitely be identified as belonging to the type *Forastero*. Another point of great interest which has been observed by Prof. Stahel is that on this natural growth of cacao can be found the witch's broom disease, *Marasmius perniciosus*. This disease, which is only known upon cacao, has of recent years made very serious inroads upon the Surinam plantations, which are some 175 kilometres distant from the valley where the native trees grow, on which the disease occurs to a very large extent. The *Kew Bulletin* contains an account by Dr. J. G. Myers of his visit to this locality for native cacao on behalf of the Empire Marketing Board. Dr. Myers had in view the possibility of the biological control of the more important insect pests of cacao in the West Indies. However, the chief insect pests of cacao were not found attacking the wild tree, which seems to suggest that thrips and the cacao beetle have become attracted to cacao, from other wild host plants, since it has come under extensive cultivation.

Soil Science in Sweden.—The recent appearance of the second number of vol. 3 of *Forestry*, the journal of the Society of Foresters of Great Britain, shows that the high-level efficiency of the publication is maintained. An interesting paper in this issue is "Forest Soil Science in Sweden", by G. V. Jacks. Mr. Jacks' paper discusses the position to which the researches in soil science have reached in Sweden since the first serious inquiries were undertaken and the foundations laid by the work of Sveriges Geologiska Undersökning in the middle of last century. Since the beginning of the present century the work has proceeded under the auspices of the Statens Skogsförsöksanstalt, an institute under State control. Prof. Hesselman, who was responsible for assembling the International Congress of Forest Research Stations which met at Stockholm in July last (a description of the proceedings of which is also given in the present issue), is the president and is assisted by Dr. O. Tamm, geologist, and Dr. C. Malmström, botanist. The soil investigations have been mainly carried out with a practical, usually forestry, end in view, but they have involved a great deal of research of a purely scientific value. Mr. Jacks' paper is therefore well worth consideration on both counts.

Rust Recurrence on Indian Wheat.—This subject formed the theme of Prof. K. C. Mehta's presidential address to the Botanical Section of the Indian Science Congress (*Proc. Sixteenth Indian Sci. Congr.*, Madras, 1929), in which he gave a very clear account of the interesting conclusions that follow from his own work upon this subject. It would appear that on the plains, rusts on wheat are only found over a period of three months in each year; the uredospores are then killed by the summer heat and no source of rust infection is left upon the field when the new crop is sown. With each species of wheat rust investigated, the source of reinfection appears to be in the hill country, where the uredospores survive through the critical summer period on self-sown plants and tillers. Prof. Mehta's earlier experience upon the overwintering of rusts in England, when working with Mr. F. T. Brooks at Cambridge, may have helped him in reaching this conclusion; his case is stated temperately and clearly and seems to be based upon long and careful observation, involving considerable travelling. Prof. Mehta complains that the progress of this important investigation has been delayed by lack of financial support. This would seem surprising in the case of such an important practical problem. His results suggest that, with financial support, it might be possible to attempt some control of rust dissemination on wheat, by attempting the eradication of the rust hosts in some of the hill localities, or controlling more carefully the growth of wheat in regions where the rust is able to overwinter.

Irrigation in India.—Some interesting figures appear in the review for 1927–28 of irrigation in India, published by the Department of Industries and Labour of the Government of India. The monsoon broke about the usual time and its progress was normal, but there was a slight deficiency of rain in many of the plain areas. The total area irrigated in British India by government works of all classes was twenty-seven and a half million acres, which amounted to 11·5 per cent of the total area sown. In Sind, the irrigated area was 76·8 per cent of the total area; in the Punjab 35·2 per cent; and in the Madras Presidency 18·6 per cent. In most of the provinces further irrigation works are in progress. Details are given of these and of projects under consideration. One of the most important schemes in hand is the Sukkur barrage on the Indus. Important works are also on hand in the North-West Frontier Province, where drainage works are being constructed to relieve the waterlogged soil of the irrigated areas. This has already resulted in heavier crops and the recultivation of many acres which for long have been lying waste.

Multiple Origin of the Japanese Earthquake of 1923.—Two papers have recently been published on the multiple origin of this earthquake. Prof. A. Imamura (*Tokyo Imp. Acad. Proc.*, vol. 5, pp. 330-33; 1929) shows that the initial portion of the seismogram at Tokyo contains three distinct phases due to movements from different centres. The first came from an origin in Sagami Bay to the north of the island of Oshima, the second 3 seconds later and much stronger from one near Mount Tanzawa, about 18 miles to the north-north-west, and the third and greatest of all, after 4½ seconds more, from a centre about half-way between. Prof. Imamura remarks that the varying directions of the initial motion are explained by the existence of these different centres. He also shows, from a study of the measured changes of level, that faults with noticeable scarps are continued for some miles either as faults or flexures, some of them more than 12 miles in length. Prof. Koto (*Jour. Fac. Sci., Tokyo Imp. Univ.*, vol. 3, pp. 1-21; 1929) refers to the existence of a contributory seismic zone about nine miles to the north of Tokyo along the valley of the old river Ara-kawa. After the earthquake of 1894, he traced a fault-track 18 miles in length along this valley, and, after the earthquake of 1923, he mapped a broad destructive area along the same zone.

Geological Structure of New Zealand.—A most valuable paper to students of tectonic geology in general and of New Zealand in particular is contributed by Dr. J. Henderson to the *N.Z. Jour. Sci.*

and Tech., vol. 11, Aug. 1929. It is illustrated by a map showing the main structural lines, depressions, and lowlands of the islands, and by two large-scale maps (prepared by the late Mr. P. G. Morgan), which are not issued with the *Journal* but can be obtained by subscribers from the editor. New Zealand is regarded as the shattered crest of two crustal upbowings that meet at right angles in the Taupo region, the earth stresses involved having been active during the late Tertiary. Theoretically, the shear zone due to horizontal pressure in the crust should curve upwards from a horizontal sole, reaching the surface as a fracture curved in plan and dipping steeply. The block rises vertically in front and rotates on the curved surface on which it rests. The original upper surface of the block thus comes to be tilted away from the inner side of the fault trace. Many of the faults and blocks of New Zealand show features in close agreement with theory. There is good evidence for the following statements: (1) The mountain-building faults, wherever observed, dip steeply. (2) Many of the faults are arcuate in plan. (3) Many blocks are back-tilted from the bordering fault. (4) Many blocks are highest near the central part of the fault. (5) Several faults grade into anticlines. The north-east trending crustal ridge of which New Zealand is the highest part may be considered as the upthrust edge of a gigantic earth block with its frontal scarp overlooking the Tonga Deep. Pressure at right angles has raised on this block a number of isolated north-west trending ridges, of which the Auckland Peninsula and New Caledonia are examples.

Elastic and Electric Properties under Pressure.—The December issue of the *Proceedings of the American Academy of Arts and Sciences* contains two papers by Prof. P. W. Bridgman of Harvard which continue his long series on the properties of substances under hydrostatic pressures of the order of 12,000 atmospheres. The first shows that, in general, pressure increases the modulus of rigidity of a metal less than 6 per cent per 10,000 atmospheres, and in the case of two rare metals diminishes it slightly. In the second, the compressibilities of four single crystals of metals, seven of inorganic and four of organic substances, and lastly of bakelite, are determined. The diminution of 1 cm. parallel to an axis of a crystal due to a hydrostatic pressure of 12,000 atmospheres is of the order 1 to 6×10^{-6} cm. and varies almost as much from one axis to another in the same crystal, particularly in inorganic crystals. The electrical resistances of indium, manganese, chromium, and arsenic all decrease with increase of pressure and are thus normal, while arsenic appears to undergo a modification of form at 5500 atmospheres.

Properties of Ammonia. — The thermodynamic properties of ammonia are of considerable importance in connexion with its use in refrigeration. In the January number of the *Journal of the American Chemical Society*, Beattie and Lawrence deal with these properties and describe experiments on the compressibility of gaseous ammonia and the vapour pressures of liquid ammonia from 30° to 132°. An equation of state for the gas is derived from the first set of experiments; the vapour pressures are in agreement with those found by the U.S. Bureau of Standards and by Keyes and Brownlee.

Combustion of Charcoal.—The nature of the chemical reactions involved in the combustion of charcoal has long been a matter of investigation and dispute. The theory usually accepted at present is that put forward by Rhead and Wheeler in 1912 on the basis of experiments, namely, that the oxygen is first attached to the carbon in the form of a loosely formed complex, C_xO_y, which at higher temperatures decomposes into carbon monoxide and dioxide. The view that the oxygen is adsorbed is also tenable, especially since Langmuir has identified the forces holding adsorbed molecules on surfaces as primary or residual valency forces of the atoms composing the surface. The fact that the adsorbed oxygen cannot be removed as such by reducing the pressure, and appears to be firmly bound, is better explained by Rhead and Wheeler's theory, although Richardson in 1917 could find no evidence of a complex oxide in the study of the reverse action of carbon dioxide on charcoal at relatively high pressures. In the December number of the *Journal of the Chemical Society*, M. S. Shah describes experiments on the combustion of charcoal in oxygen, nitrous oxide, and nitric oxide. It is well known that brightly burning charcoal burns more brilliantly in nitrous oxide than in air, but does not continue to burn in nitric oxide, although the latter contains more oxygen. He considers this anomalous, although it is usually explained by the undoubtedly greater thermal stability of nitric oxide. The main result of the work is that the initial stage in all three cases seems to be due to fixation of oxygen. Charcoal retains nitric oxide as well as oxygen; reaction then proceeds between the charcoal and the fixed gases, and the ultimate products are carbon dioxide and nitrogen. Even in a rapid stream of gas no carbon monoxide was detected, whilst with oxygen and nitrous oxide both monoxide and dioxide were formed. Shah prefers Langmuir's adsorption theory to the chemical complex theory of Rhead and Wheeler, and shows how, when suitably modified, it is capable of explaining his results.

Power Measurement in an Alternating Current Circuit.—One of the most difficult problems which electrical engineers have to solve is the measurement of the power in an alternating current circuit. The measurement of direct current power is easy; one has merely to measure the current and the pressure and multiply them together. This can be done by a single instrument called a wattmeter, which can be calibrated with a maximum inaccuracy of about the tenth of one per cent. Wattmeters suitable for measuring alternating power at high voltage when the current is large are much more difficult to construct. In calibrating the instrument, not only have the current and the voltage to be measured but also the difference of phase between them. The mean power is the product of the voltage and the current into the cosine of the phase difference. As transformers have to be used to reduce the pressure and voltage to values which can be measured by voltmeters and ammeters, the transforming ratios of these devices have to be very accurately determined. As the power to be measured is far larger than any available in a testing laboratory, artificial 'loads' for the meters have to be made up, the voltage coil being actuated by one circuit and the ampere coil being actuated by another, the circuits being arranged so that the phase difference between the currents flowing in them can be accurately calculated. At the Institution of Electrical Engineers on Feb. 7, three papers dealing with this problem were read. The first paper, by G. F. Shotter, described a null method of testing instrument transformers. The second paper, by R. S. J. Spilsbury and Dr. Arnold of the National Physical Laboratory, described the accessory apparatus required for the precise measurement of large currents. In the third paper Dr. Arnold described a rapid and accurate method of testing current transformers by means of a potential-divider bridge.

History of Medicine.

TWO interesting lectures connected with the history of medicine were delivered at the Wellcome Medical Historical Museum at the end of last month by Sir William Willcox and Dr. A. P. Cawadias respectively. The former, who chose the subject of secret poisoning for his address, stated that the recent excavations in Mesopotamia have shown that an interest in poisons could be traced back to about 4500 B.C., when a goddess named Gula was worshipped by the Sumerians under the name of The Mistress of Charms and Spells and Controller of Noxious Poisons. The first scientific student of poisons, however, appears to have been Mithridates, king of Pontus, who not only conducted toxicological experiments on condemned criminals and others, but also wrote a book on the subject and invented a universal antidote which, according to Celsus, consisted of thirty-six ingredients. It is recorded that when he wished to commit suicide by poison, rather than surrender to the Roman invader, his constitution had become so inured to various poisons that his attempt was unsuccessful and he had to ask a mercenary to dispatch him with a sword. His name survives in modern scientific nomenclature, in the term 'mithridatism', which signifies immunity to poisons, bacterial and otherwise, acquired by gradually increasing doses of the poison itself.

During the Roman Empire, Agrippina and her son Nero made elaborate studies in experimental toxicology on the human subject, and by the knowledge thus obtained successfully removed the persons who incurred their disfavour. In the course of the next thousand years, poisoning was extensively practised without, however, any great developments taking place in the science of toxicology, and it was not until the time of the Italian Renaissance that an intensive study of poisons was made, the most notorious experts in this field being Pope Alexander VI. and his son Cæsar Borgia.

Until modern times, the methods of detection of poisons depended mainly on the circumstances attending their administration. Nothing was really known about the post-mortem appearances, and toxicology did not make any great advance until the development of modern chemistry and its application to the analytical problems with which toxicology is concerned. While the only certain sign of poisoning is the identification by analysis of the poison in the body, of recent years so much progress has been made in morbid anatomy and histology that the post-mortem appearances often indicate the poison responsible for death apart from its detection in the body by chemical analysis. In conclusion, Sir William Willcox illustrated his address by the exhibition of curious poisons and their antidotes from the museum.

Dr. Cawadias, whose address was entitled "From Epidaurus to Galen: The Principal Currents of Greek Medical Thought", maintained that rational medicine was invented by the Greeks and that before their time the general attitude towards disease was irrational, medicine being essentially religious and magical in character. Although faith-healing was an important feature in the cult of Æsculapius at Epidaurus, it was limited to special cases of non-organic disease, and was free from the mystic element of the religious medicine of the ancient peoples of the East. Every period of ancient Greek medicine, of which five can be distinguished, is based on the physiological work of the ancient Ionian natural philosophers such as Thales and Anaximander.

In the first period, which included the seventh, sixth, and early fifth centuries B.C., a method of diagnosis based on physiological considerations with very elementary clinical control was elaborated together with rules for diet and gymnastics. In the second period, which included the fifth and fourth centuries B.C., Greek medicine became based on more precise physiological knowledge gained mainly by the researches of Anaxagoras of Clazomenæ, Democritus of Abdera, and Diogenes of Apollonia. The general mechanism of disease was explained more precisely by the doctrines of Hippocrates. Clinical medicine reached its zenith through the method of nosographical diagnosis developed by the Cnidians as well as by the method of personal diagnosis devised by Hippocrates and the school of Cos.

The doctrines of the third period, which included the last three centuries B.C. and the first two centuries A.D., were based on the physiological works of Aristotle and marked a very great advance in the knowledge of the functions of the various organs. This physiological work was supplemented by the Alexandrian physicians Herophilus and Erasistratus. Numerous medical schools flourished during this period. While the Alexandrians of the third century B.C. controlled research in physiology by a strict clinical examination, the Methodists and Pneumatists made physiology the sole basis of diagnosis and neglected the clinical method. The Empirics, on the other hand, confined themselves to clinical considerations and refused to consider any diagnostic method connected with the physiological mechanism of disease.

The fourth period of Greek medicine is represented by Galen alone (A.D. 130–200), whose physiological work marked an enormous advance on that of Aristotle owing to the introduction of the experimental method. The fifth and last phase of Greek medicine was a period of compilation and transmission, the principal compilers being Cælius Aurelianus (A.D. 400), Oribasius (A.D. 326–403), Alexander of Tralles (A.D. 525–605), and Paulus of Ægina (A.D. 600–650). Their compilations were used by the Nestorian monks, who transmitted Greek medicine in the sixth and seventh centuries to the Arabians and through them in a slight degree to western Europe. The transmission of Greek medicine, however, was mainly due to the Greek scholars of the fifteenth century, who had left Greece after its conquest by the Turks.

Cotton in Africa.

THE report of the executive committee of the Empire Cotton Growing Corporation to the meeting of the administrative council, held in Manchester on Jan. 21 last, contains several important scientific observations on the growth of cotton in Africa.

The diseases and pests which attack the cotton plant are many, and each locality has its particular problems to solve in breeding resistant strains. Cotton growing in South Africa has suffered from attacks by the jassid insect, and it is interesting to note that a strain has been isolated which is resistant to this pest. The new strain of cotton is giving high yields, which is of primary importance to the grower, and recent experience has shown that it is capable of giving good crops in districts with a seasonal rainfall of 10 inches, whereas it is generally considered that a minimum of 20 inches is necessary for cotton

growing. In Uganda, one of the most promising cotton-growing regions in South Africa, there are good prospects of increased yields, and steps are being taken to ensure this by instructing the native growers in improved methods of cultivation, and by effectively controlling the seed supply.

The cottons which the Corporation is cultivating in South Africa are of the American type, and are intended to provide the Empire with sources of supply other than America. It is to the Anglo-Egyptian Sudan that we have to look for the supply of the better quality cottons of the Egyptian type. The Sudan is now producing an increasing quantity of cotton which is almost indistinguishable from the best qualities of long staple Egyptian cotton. Recently the disease known as leaf curl has been attacking the crops in this locality, and there is evidence that the jassid insect is responsible for spreading the contagion. The Corporation is now considering the desirability of breeding jassid-resistant strains in the Sudan.

The Corporation, during the first years of its activities, found difficulty in obtaining agricultural scientific officers of adequate experience, but it is pleasing to note that it is now able to arrange for its senior officers to visit cotton-growing localities outside their own charge. Much good is expected of this interchange of thought and knowledge born of long experience, and the scheme should stimulate the younger officers who are striving to make headway in recently opened cotton-growing areas.

It is unfortunate that the continued depression in the cotton industry has made it necessary to reduce the spinners' levy from 3d. to 1d. per 500 lb. of raw cotton, but the Corporation will be able to carry out its full programme for the coming year by drawing on its accumulated reserves. The burden on the Corporation has been reduced in recent years by the increasing share that colonial governments are now taking in the cost of developing cotton growing, and also because the Colonial Office is now training men for agricultural appointments on the lines initiated by the Corporation. F. P. S.

Meteorological Conditions accompanying a Waterspout.

AT 9.31 A.M., on June 14, 1929, a waterspout formed over Pensacola Bay, Florida, three hours after Lieut. P. G. Hale of the U.S. Navy had obtained accurate records of the pressure, temperature, and humidity of the atmosphere up to a height of 3000 metres close to the place where the spout developed. Mr. Hale also secured an admirable photograph of the phenomenon, taken from an aeroplane, which shows that the spout took the usual form of a sharply defined cord-like cloud stretching in a rather sinuous curve from the base of a cumulo-nimbus cloud to the sea, with a cloud of spray at its base.

At the time of the sounding, there was a dust horizon to the east at a height of about 2800 metres, and tall cumulus clouds were thrusting their heads through the haze top. Additional evidence of atmospheric instability was furnished by the graph of temperature and entropy plotted on a Shaw 'tephigram', which is reproduced together with the photograph in a short article in the *Monthly Weather Review* for August 1929. The article is of especial interest, owing to the attention directed to the subject by Wegener's recent introduction of the theory that the visible part of a waterspout is the extension of a whirl with a horizontal axis within the parent cumulo-nimbus cloud, and also because the chances are so against an aerial sounding happening to be made such a short time before the occurrence of a spout.

The 'tephigram' reveals an atmospheric environment such that a very moderate amount of general heating of the lower layers of the atmosphere, or, alternatively, a slight increase of their water-vapour near the surface, would allow any portion of the surface air with a little extra warmth or moisture to ascend automatically. It shows, further, that the ascending air would have possessed a large amount of surplus energy beyond that required merely for its ascent, such energy being available for developing the kinetic energy corresponding with the violent winds around the axis of a waterspout. This is the kind of information that a glance at the 'tephigram' will reveal to anyone familiar with it.

When we read that the construction of a 'tephigram' is a matter of daily routine for weather forecasting at the Pensacola air-station, it becomes clear that the thermodynamical researches of Carnot, Clausius, Maxwell, and others are beginning—mainly owing to Von Bezold in Germany and Napier Shaw in Great Britain—to have novel fields of practical application.

University and Educational Intelligence.

BIRMINGHAM.—The annual meeting of the Court of Governors of the University is to be held on Feb. 27, and the reports of the Vice-Chancellor and the Council, which are to be presented to the Court, have been issued. The Vice-Chancellor, Sir Charles Grant Robertson, reviews the changes which have occurred during the ten years of his tenure of office and is able to report much progress. The income and expenditure have greatly increased, and it is satisfactory to note that the largest item of expenditure is that of salaries. Nine members of the non-professorial staff have been promoted to Grade I. with a minimum salary of £600 a year—a reform long overdue. The number of students continues to increase slowly.

The eighth annual report of the Joint Standing Committee for Research shows an imposing array of subjects of research in aid of which grants have been made, and enumerates the publications of the various departments of the faculties of science, arts, medicine, commerce, and law. The report indicates a healthy activity in research over a wide range of subjects.

The event of the greatest moment to the University is the development of the new hospital scheme, in which an important step has been taken in the selection of plans for the buildings. If the money is forthcoming (£1,000,000 has been mentioned) a magnificent group of buildings will arise, on a site near to the University grounds, to accommodate the hospital and the University Medical School.

CAMBRIDGE.—Mr. W. R. Dean, of Trinity College, has been appointed University lecturer in mathematics.

LONDON.—The Court of the University has gratefully accepted a bequest by the late Lady Durning-Lawrence of £10,000 for the equipment of the Physical and Electrical Chemistry Laboratory at University College.

NOTICE is given by the University of Wales that five fellowships, each of the annual value of £200 and tenable for two years, are to be awarded during the present year to graduates of the University. Applications for the fellowships should be sent by June 1 to the Registrar, University Registry, Cathays Park, Cardiff.

Historic Natural Events.

Feb. 23, 1887. Earthquake.—The Riviera earthquake was not one of great strength, for only 640 persons were killed, while the area disturbed contained 219,000 sq. miles. The earthquake is, however, interesting on two accounts. It was one of the early earthquakes in which the existence of two foci was recognised. It was also one of the first to be registered by instruments far beyond the disturbed area, magnetographs being displaced at Kew, Wilhelmshaven, and Lisbon, which are respectively 652, 690, and 951 miles from the epicentre.

Feb. 24, 1575. Flood of Flies and Beetles.—According to Holinshed, at Tewkesbury, "after a flood which was not great, but such as thereby the meadows near adjoining were covered with water, in the afternoon there came down the river of Severn great numbers of flies and beetles, such as in summer evenings use to strike men in the face, in great heaps, a foot thick above the water, so that to credible men's judgments there were seen, within a pair of butt's length, of those flies above a hundred quarters. The mills thereabouts were dammed up with them for the space of four days after, and then were cleansed by digging them out with shovels. From whence they came is yet unknown, but the day was cold and a hard frost."

Feb. 24, 1844. Mild Winter.—"I tell you that we have had the mildest winter known. . . . The extraordinary fine season has killed heaps of people with influenza, debilitated others for their lives long, worried everybody with colds, etc."—FITZGERALD.

Feb. 26, 1658. Severe Winter.—The winter of 1657–8 was very rigorous. On Feb. 26 Charles X. of Sweden crossed from Fuenen to Zealand across the ice, with all his army, cavalry, artillery, and baggage. The ports of Ostend and Sluys were blocked by ice, and even in Italy the rivers were frozen so solidly that they supported the heaviest carriages. In Rome at the beginning of February was the greatest snowfall of the century. The Seine was frozen, and the thaw was followed by a flood on Feb. 27–28, greater than any previously recorded. In England the cold was severe, with persistent northerly and north-easterly winds. On Mar. 7, Evelyn wrote: "This had been the severest winter that any man alive had known in England". Spring appears also to have been backward, for on June 12 he wrote: "The season as cold as winter, the wind northerly near six months".

Feb. 26–27, 1903. Gale.—On the night of Feb. 26 and the morning of Feb. 27 a deep barometric depression travelled north-eastwards across the British Isles. The barometer fell below 958 mb. (28·3 inches) and the winds reached nearly 90 miles per hour in squalls. The south-westerly gale over Ireland was described as the most violent since the 'big wind' of Jan. 6, 1839; thousands of trees were uprooted and much damage was done to buildings. On Leven Viaduct, near Ulverston, a train consisting of ten passenger coaches and vans was overturned by the force of the wind.

Feb. 28, 1540. Beginning of Great Drought.—The year 1540 was extremely hot and dry both in England and in central Europe, probably the hottest on record and comparable for drought with 1000 and 1473. In England rain fell only six times between February and Sept. 19, and in Zurich only four times during the same period. In Regensburg and Milan there was practically no rain for five months. In Switzerland it was known for a century as 'the hot summer'. The following year, 1541, was also very dry in England, and the combined effect of these two years had serious consequences. Almost all the small rivers dried up, the River Trent diminished to a straggling brook, and the Thames fell so low that even at ebb tide sea-water extended beyond London Bridge—an unheard-of phenomenon at that time. Many cattle died for want of water, especially in Nottinghamshire, and many thousands of persons died from grievous diarrhœa and dysentery.

Societies and Academies.

LONDON.

Royal Society, Feb. 13.—G. Slater: Studies on the Rhone Glacier, 1927. The structure of the ice in a compressed zone on the south-eastern part of the glacier. This zone is marked by a series of ridges dissected by three crevassed longitudinal basins. The structure of the easterly ridge, which was plotted to scale, showed a complete disarrangement of the normal ribbon-structure, the ice being dissected into blocks by thrust-planes. The general strike of the thrust-planes suggests a deviation of the ice southwards from the normal south-westerly movement of the glacier. Relief from pressure was obtained by upward movement along thrust-planes, and by lateral squeezing towards the tensional areas. The structure developed in the glacier is the same in principle as that of the disturbed Pleistocene drift deposits of Europe and America.—T. Goodey: On a remarkable new nematode, *Tylenchinema oscinellæ* gen. et sp. n., parasitic in the frit-fly, *Oscinella frit* L., attacking oats. The parasite is widely distributed in England and Wales; its life-history and the development of the gonad for both sexes are described. The general result for the host is sterilisation.—D. E. Sladden: Distortion of development in amphibia caused by lack of oxygen in very early stages in development. Eggs of the common frog deprived of oxygen, either by sugar solution or by reduced air pressure, gave rise to tadpoles showing various types of abnormalities. The abnormalities present at the time of hatching died shortly after, leaving only apparently normal larvæ. From among these, however, after a period of about eight weeks, abnormalities showing flexure in tail, distortion of sacral region, and in one case suppression of hind limb, made their appearance. These latter were successfully reared through metamorphoses.—Sir Frederick Keeble, M. G. Nelson, and R. Snow.—The integration of plant behaviour. (Pt. 2) The influence of the shoot on the growth of roots in seedlings. By removing the shoot in young pea seedlings or the shoot and coleoptile in young maize seedlings, the growth of the main root is slightly increased for a few days, but the growth of secondary or adventitious roots is very greatly decreased. By removal of the coleoptile alone in young maize seedlings, the growth of adventitious roots is decreased, but to a much less extent.—A. W. Greenwood and J. S. S. Blyth: The results of testicular transplantation in brown Leghorn hens. Persistent grafts of testicular substance have been obtained in a series of normal hens. Modification in the functions of the ovary have been produced, both in regard to the production of eggs and to the development of the secondary sex characters.

Geological Society, Jan. 22.—J. W. Gregory, Ethel Dobbie Currie, J. Weir, S. Williams, and G. W. Tyrrell: On the geological collection from the South Central Sahara made by Mr. Francis Rodd. The Aïr Massif in the South Central Sahara was shown by the work of Barth (1857) and Chudeau (1907, etc.) to consist of a foundation of gneiss, schist, and granite, on which rest in the north and west sheets of Devonian marine beds,

and in the south Cretaceous limestones and subaerial sandstones. The gneiss and schists are probably pre-Palæozoic. At In Nuguren, west of the Aïr massif, there are well-preserved Turonian fossils affording evidence of a connexion of the sea in Angola with that of the Mediterranean across the Central Sahara. Some terrestrial deposits earlier than the Turonian limestones contain silicified fossil wood identified as *Dadoxylon*. The igneous rocks collected represent a northern extension of the Kainozoic volcanic series of Kenya and Kordofan. The Cretaceous limestones indicate that the Central Sahara was partly submerged by a Turonian transgression, which connected the Angola Gulf and the Lower Niger with Tunisia. It had a branch westward through In Nuguren towards the Middle Niger, but had no known connexion across Abyssinia with Somaliland or the Gulf of Aden.—J. V. Harrison: The geology of some salt-plugs in Laristan (Southern Persia). The area is contained in the rectangle between lat. 27° and lat. 28° 20′ N., and long. 54° 20′ and long. 57° E. Much of the district is covered by normally folded rocks which range in age from Ordovician to Recent, and reach an aggregate thickness of 25,000 feet. The only general angular unconformity occurs high in the Mio-Pliocene. On the north and east the frontal part of the nappes overrides and ploughs into the normally folded rocks. South and west of the line of nappes the normal folds have been invaded by plugs of salt, which have brought up quantities of gypsum and blocks of sedimentary and igneous rocks. The extrusive salt has come to the surface at different times, from Oligocene to late Mio-Pliocene. The intrusive salt-masses, sheathed with autochthonous sediments tilted around them, form, in some cases, brightly coloured mountains of very striking and characteristic appearance. The formation of the salt-plugs is attributed to tangential forces acting on Cambrian salt, which, on account of its comparative plasticity, has acted as something analogous to an igneous magma in its behaviour.

PARIS.

Academy of Sciences, Jan. 13.—The president announced the death of Auguste Rateau.—**Ch. Fabry** and **E. Dubreuil**: A supposed transformation of lead by the effect of solar radiations. Criticism and correction of some results recently published by Mlle. S. Maracineanu. No trace of either gold or mercury could be found in the specimens of lead examined.—**Ch. Achard** and **M. Enachesco**: The reciprocal action of chlorination and alkalinisation of the organism in acute diseases.—**Maurice de Broglie**: The use of gratings at grazing incidence for spectrophotography of the extreme ultra-violet. J. Thibaud was the first to apply the use of a grating at grazing incidence to the study of the radiations in the ultra-violet. An account is given of subsequent developments of the method, with special reference to the X-rays.—**Pierre Weiss**: The diamagnetism of the ions.—**S. Lefschetz**: Continued transformations of closed ensembles and their fixed points.—**Marcel Brelot**: The exterior problem of Dirichlet for the equation $\Delta u = c(x, y)u(x, y)(c>0)$.—**A. Métral**: An essential character of conformal representations utilisable for planning the profiles of the wings of aeroplanes.—**Carl Störmer**: The absence of retarded (wireless) echoes during totality of the eclipse of May 9 in Indo-China.—**L. Gaurier**: The alteration of the alluvium of lakes converted into reservoirs.—**L. Pirot**: The deviation from the vertical round the peninsula of Brittany.—**Guichard, Clausmann, and Billon**: The variations of the hardness of certain metals and alloys as a function of cold hardening.—**Carl Benedicks**: The density of some iron alloys in the liquid state.—**Edlén** and **Ericson**: The condensed spark spectrum in the extreme ultra-violet to 88 A.—**Georges Fournier**: An arithmetical relation between the atomic weight and the atomic number.—**P. Mondain-Monval** and **Pierre Galet**: The anomalies of the physical properties of the vitreous state. The case of amorphous sulphur and selenium. The viscosity measurements of sulphur, which were made by a form of penetrometer, showed a sharp change in viscosity at −21° C.: a study of the density changes showed a point of transformation at −20° C. Similar measurements with selenium gave a clear point of inflection on the viscosity curve at 45° C. and on the density curve at 31°-33° C. As in the case of glass, at a temperature slightly below the softening point, sulphur and selenium undergo an allotropic transformation: this takes place with a diminution of viscosity, an increase in the coefficient of expansion, and a sensible heat absorption.—**Pierre Brun**: The boiling points of aqueous alcoholic liquid mixtures. Experiments on ternary mixtures of water, ethyl alcohol, and isoamyl alcohol have been made and the results given in a triangular diagram.—**Maurice François**: The action of concentrated ammonia on the compound $HgBr_2 2NH_3$. The formation of HgH_2NBr and Hg_2NBr.—**Marcel Guillot**: An attempt to prove the existence of a non-electrolytic complex of polonium. The experiments described point to the probable existence of a complex substance of the formula $Po(-S-CS-NR_2)_3$.—**Daniel Schnéegans**: The presence of radiolarites in the Briançonnais sheet.—**Pierre Dangeard**: The influence of oxygen in iodo-volatilisation. Experimental proof that gaseous oxygen is necessary for the emission of iodine by *Laminaria*. It is suggested that the negative results obtained by H. Kylin were due to the non-recognition of this fact.—**Raymond-Hamet**: The action of ouabaine on the intestine *in situ*. The intestine when isolated is contracted by ouabaine, but the intestine *in situ* is relaxed by the alkaloid.—**J. Enselme**: Contribution to the study of the acid hydrolysis of the proteids.—**Mme. Phisalix**: Natural immunity against snake poison and the virus of rabies of the common dormouse, *Eliomys nitela*. This animal shows no sign of poisoning after being bitten by the viper. In battles between the dormouse and the viper, the former always takes the offensive and the snake is invariably killed. The dormouse is also immune to intra-muscular injections of the rabies virus. The serum of the dormouse *in vitro* neutralised the rabic virus. The immunity of this animal towards both snake poison and the virus of rabies is due to the existence in the blood of anti substances.

GENEVA.

Society of Physics and Natural History, Dec. 19.—**F. Chodat**: A new demonstration of the Traube cell. The author proves the penetration of water into the semi-permeable copper ferrocyanide membrane cell. The progressive flocculation of egg albumen incorporated in the cell allows the measurement by nephelometry of the velocity of penetration by the water.—**Ed. Parejas**: Would the Geneva basin lend itself to a study of glacial varves? The author, from the researches which he has made in the eastern part of the Lake of Geneva, considers it probable that the Geneva basin (western part) would lend itself, by the study of the varves, to an attempt at the synchronisation of the Alpine and Scandinavian post-glacial deposits.—**G. Tiercy**: On four 'mean' curves relative to the Cepheids. The author has recently terminated the study of two variable stars of the Cepheid type; he proves that the new results agree very well with those that he has previously obtained for other Cepheids.

Official Publications Received.

BRITISH.

War Office. Report on the Health of the Army for the Year 1928. Vol. 64. Pp. iv+144. (London: H.M. Stationery Office.) 5s. net.

Report on a Visit to Kenya and Uganda to advise on Antimalarial Measures. By Dr. S. P. James. Pp. 48. (London: The Crown Agents for the Colonies.) 1s.

Royal Society of Arts, John Street, Adelphi, London, W.C.2. Report on the Competition of Industrial Designs, 1929. Pp. 51. (London.)

Journal of the Indian Institute of Science. Vol. 12A, Part 15: The Electrical Conductivity of Thin Oil Films. Part 1: General Nature of the Phenomenon. By H. E. Watson and A. S. Menon. Pp. 207-224. 1 rupee. Vol. 12A, Part 16: The Photo-Voltaic Properties of Phototropic Mercury Compounds. By Bh. S. V. Raghava Rao. Pp. 225-232. 8 annas. (Bangalore.)

Proceedings of the Royal Society of Victoria. Vol. 42 (New Series), Part 1, October 31st, 1929. Pp. v+70. (Melbourne.)

The Institute of Metals. List of Members, including Membership Application Form and Topographical Index to Members. (Corrected to December 31, 1929.) Pp. 107. (London.) 2s. 6d.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 14: The Work of the Division of Economic Botany for the Year 1928-29. By Dr. B. T. Dickson. Pp. 29. Pamphlet No. 15: The Work of the Division of Economic Entomology for the Year 1928-29. By Dr. R. J. Tillyard. Pp. 19. Pamphlet No. 16: The Work of the Division of Animal Nutrition for the Year 1928-29. By Prof. T. Brailsford Robertson. Pp. 30. (Melbourne: H. J. Green.)

Commonwealth Prickly-Pear Board. The Progress of Biological Control of Prickly-Pear in Australia. By Alan P. Dodd. Pp. 44. (Brisbane: Anthony James Cumming.)

FOREIGN.

Transactions of the San Diego Society of Natural History. Vol. 5, No. 20: Fossil Diatoms dredged from Bering Sea. By G. Dallas Hanna. Pp. 287-296+plate 34. (San Diego, Calif.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 12, No. 6, November 1929. Pp. 275-379. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.50 yen.

University of California Publications. Bulletin of the Department of Geological Sciences, Vol. 19, No. 1: The Passerine Remains from Rancho La Brea in the Paleontological Collections of the University of California. By Allen H. Miller. Pp. 22+1 plate. (Berkeley, Calif.: University of California Press.) 25 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 53: Further Researches on Periodic Columnar Vortices produced by Convection. By Torahiko Terada and Mituo Tamano. Pp. 447-470+plates 17-31. (Tôkyô: Koseikai Publishing House.) 0.70 yen.

United States Department of the Interior. Annual Report of the Commissioner of Education for the Year ended June 30, 1929. Pp. iii+50. (Washington, D.C.: Government Printing Office.) 10 cents.

United States Department of Agriculture. Technical Bulletin No. 145: Life History and Habits of Grasshopper Mice, Genus Onychomys. By Vernon Bailey and Charles C. Sperry. Pp. 20. 10 cents. Circular No. 96: Game Birds suitable for Naturalizing in the United States. By W. L. McAtee. Pp. 24. 10 cents. (Washington, D.C.: Government Printing Office.)

Société Française de Physique. Annuaire 1929, Décrets et Statuts. Pp. 105. (Paris.)

Det Kongelige Departement for Handel, Sjøfart, Industri, Håndverk og Fiskeri. Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard og Ishavet. Nr. 1: The Norwegian Svalbard Expeditions 1906-1926. By Adolf Hoel. Pp. 104+3 plates. 10.00 kr. Nr. 19: Das Festungsprofil auf Spitzbergen. Jura und Kreide, 2: Die Stratigraphie. Von Hans Frebold. Pp. 40+1 Tafel. 3.00 kr. Nr. 20: Oberer Lias und unteres Callovien in Spitzbergen. Von Hans Frebold. Pp. 24+2 Tafeln. 2.50 kr. Nr. 21: Ammoniten aus dem Valanginien von Spitzbergen. Von Hans Frebold. Pp. 24+8 Tafeln. 4.00 kr. Nr. 22: Die Downtonischen und Devonischen Vertebraten von Spitzbergen. 2: Acanthaspida. Von Anatol Heintz. Pp. 81+24 Tafeln. 15.00 kr. Nr. 23: Die Downtonischen und Devonischen Vertebraten von Spitzbergen. 3: Acanthaspida, Nachtrag. Von Anatol Heintz. Pp. 20+3 Tafeln. 3.00 kr. Nr. 24: Eine Caninia aus dem Karbon des de Geer-Berges im Eisfjiordgebiet auf Spitzbergen. Von Franz Heritsch. Pp. 21+7 Tafeln. 3.50 kr. Nr. 25: Untersuchungen über die Ernährung der Bewohner von Barentsburg, Svalbard. Von Otto Abs. Pp. 64+1 Tafel. 5.00 kr. Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse. Nr. 7: Jan Mayen, en Oversikt over øens Natur, Historie og Betydning. Pp. 411-444. (Oslo: Jacob Dybwad.)

Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 9. Pp. iii+172. (Kraków.)

Państwowa Rady Ochrony Przyrody. Nr. 25: Sprawozdane z Działalności, Państwowej Rady Ochrony Przyrody w Roku 1929. Napisał Prof. Dr. Władysław Szafer. Pp. 18. (Kraków.)

United States Department of Agriculture. Technical Bulletin No. 134: Red-squill Powders as Raticides. By J. C. Munch, James Silver and E. E. Horn. Pp. 36+1 plate. 10 cents. Technical Bulletin No. 135: The Corn Borer in Central Europe; a Review of Investigations from 1924 to 1927. By K. W. Babcock and A. M. Vance. Pp. 55+10 plates. 20 cents. Technical Bulletin No. 157: The Western Grass-stem Sawfly, a Pest of Small Grains. By C. N. Ainslie. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.)

Poradnik dla Samouków, Tom. 8: Botanika, 3. Dział informacyjny, Spis czasopism, Uzupełnienia do Botaniki 1 i 2 (T. 6 i 7 Poradnika), Skorowidz nazwiskowy i rzeczowy do Botaniki 1, 2 i 3. Pp. 440. (Warszawa: Kasy Imienia Mianowskiego.) 12 złotys.

Department of the Interior: Bureau of Education. Bulletin, 1929, No. 24: Record of Current Educational Publications, comprising Publications received by the Bureau of Education, January-December 1928, with Index. Pp. 128. 15 cents. Bulletin, 1929, No. 30: The General Shop. By Maris M. Proffitt. Pp. iii+27. 5 cents. (Washington, D.C.: Government Printing Office.)

Anhang zu den Jahrbüchern der Zentralanstalt für Meteorologie und Geodynamik, Jahrgang 1927. Publikation Nr. 135: Meteorologische Feldversuche über Frostabwehrmittel. Von Wilhelm Schmidt. Pp. 43+2 Tafeln. (Wien: Gerold und Komp.)

Verhandlungen und wissenschaftliche Abhandlungen des 23 Deutschen Geographentages zu Magdeburg 21 bis 23 Mai 1929. Herausgegeben von Dr. Georg Wüst. Pp. 301+12 Tafeln. (Breslau: Ferdinand Hirt.) 15 gold marks.

CATALOGUES.

Photography Simplified: Exposure. Pp. 12. (London: Burroughs Wellcome and Co.)

Zeiss Ikon Cameras for Press Work. Pp. 6. (London: Garner and Peeling, Ltd.)

Diary of Societies.

FRIDAY, FEBRUARY 21.

TEXTILE INSTITUTE (Lancashire Section) (at Textile Institute, Manchester), at 1.15.—J. Smeaton: Textile Specifications and their Preparation.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Dr. W. R. Thompson: Biological Control of Injurious Insects and Weeds.

GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting), at 3.—Presidential Address.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—Report of the Committee on Heavy-Oil Engine Working Costs, 1928-29.

LONDON SOCIETY (at Royal Society of Arts), at 5.—Sir Frank Dyson: The Royal Observatory, Greenwich.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at 11 Chandos Street, W.1), at 5.—Dr. G. E. Friend: Some Notes on the Value of Clinical, Dietetic, and Physical Records in Public Schools (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. J. B. Burt and others: Discussion on Bath Reaction in Spa Treatment

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5.—Radiology in Gastrointestinal Diseases.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—E. R. Flint: The Association between Gall Bladder Lesions and Hepatitis in the Human Subject.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University), at 6.—J. Twomey: Flour Milling.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Rear-Admiral W. Scott Hill: Powdered Coal for Ship-Propulsion.

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6.—Annual Report; Discussion on Sixth Report of the Steam-Nozzles Research Committee.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—S. H. Hart: Paper-insulated Power Cables.

TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—F. L. Goodall: Diagnosis of Colour Faults in Finished Goods.

BEDSON CLUB (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—Sir James Walker: Kolbe's Electrosynthesis (Bedson Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—R. H. Lawton: Pictorial Essentials.

GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Blackburn Technical College), at 7.—Miss E. J. Wooff: A Visit to East Sutherland.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. P. S. Gardner: The Application of Electric Welding to the Erection and Strengthening of Steel Structures.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Electro-Therapeutics Sections), at 8.—Special Discussion on The Position of Radium in Treatment of Gynæcological Conditions. Openers: M. Donaldson and S. Dodd, Obstetrics; Dr. A. E. H. Pinch and Dr. J. E. A. Lynham, Electro-Therapeutics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. B. S. Haldane: Principles of Plant Breeding.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Prof. McSwiney: The Problem of the Fastness of Dyes to Perspiration.

SATURDAY, FEBRUARY 22.

GEOLOGISTS' ASSOCIATION (in Natural History Museum, South Kensington), at 2.30.—Dr. W. D. Lang: Demonstration of Palæontology and the Public.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—G. E. Tansley: The Value of the Economiser in Present-Day Boiler Installations.—C. Howson: Notes on a Winding Accident at Mainsforth Colliery.—Exhibition and Demonstration by E. Smith of the McLuckie Gas Detector.—Discussion upon Report of an Investigation of the Underground Conveying and Loading of Coal by Mechanical Means.

ESSEX FIELD CLUB (at West Ham Municipal College), at 3.—Celebration of 50th Anniversary.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Rothenstein: Nineteenth Century Painting in France and England (1).

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Exhibition Meeting.

MONDAY, FEBRUARY 24.

INSTITUTE OF ACTUARIES, at 5.—L. K. File: Disability Benefits in Conjunction with Life Insurance Policies.

KING'S COLLEGE ENGINEERING SOCIETY (at King's College), at 5.15.—B. E. Willett: Railway Permanent Way.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Informal Discussion.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—R. L. Collett and others: Discussion on The Institute and the Chemical Profession.

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—H. Jennison: The Dyeing and Finishing of Costume Cloths.
ROYAL SOCIETY OF ARTS, at 8.—A. B. Searle: Recent Improvements in Methods of Brickmaking (Cantor Lectures) (2).
MEDICAL SOCIETY OF LONDON, at 8.—Col. L. W. Harrison and others: Discussion on The Treatment of Syphilis.
ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Dr. G. Villain: The Problem of Stabilisation and Articulation of Dentures.
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H.R.H. the Duke of Spoleto: The Italian Expedition to the Karakoram.
CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School), at 8.45.—Prof. E. A. Milne: The Principles of Radiative and Convective Equilibrium, and their Application to the Sun and Sun-spots.—*Papers to be communicated by title only:*—Sir J. Larmor: The Law of Stifling of Sound by Curtains.—J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Part VI. Isolation.—Dr. H. Jeffreys: The Draining of a Flat Plate.—S. Verblunsky: Note on the Gibbs Phenomenon.—Dr. W. R. G. Atkins and Dr. H. H. Poole: Methods for the Measurement of Daylight.—Pol Gérard: Sur l'histophysiologie des annexes fœtales des mammifères.—Dr. Muriel Elaine Robinson: Cyanogenesis in Plants.—Dr. J. Needham: The Biochemical Aspect of the Recapitulation Theory.—J. Henderson Smith: Virus Diseases in Plants.—Prof. W. Stiles: Viscosity of Protoplasm as Determining the Rate of Biological Reactions.
ROYAL AERONAUTICAL SOCIETY (at Northampton Engineering College).—C. R. Fairey: Aviation (Walmsley Memorial Lecture).
PAPER MAKERS' ASSOCIATION (Technical Section, Northern Division) (at Engineers' Club, Manchester).—S. Richardson: Removable Fourdrinier and New Mechanical Drive.
ROYAL IRISH ACADEMY (Dublin).

TUESDAY, FEBRUARY 25.

ROYAL DUBLIN SOCIETY (at Balls Bridge, Dublin), at 4.15.—Dr. W. R. G. Atkins: Some Geo-Chemical Applications of Measurements of Hydrogen Ion Concentration.—A. W. Stelfox: Explorations at Kilgreany Cave, Co. Waterford.—Prof. J. Reilly, P. J. Drumm, and T. Gray: The Nitration of Substituted Diargy Ethers.
ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—Dr. A. W. Hill: Scientific and Industrial Research in the British Empire.
ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. F. G. Chandler, A. T. Edwards, Dr. L. S. T. Burrell, and J. E. H. Roberts: Discussion on The Treatment of Lung Abscess.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: X-Ray Determination of the Structure of Cellulose and Similar Substances (3).
INSTITUTION OF CIVIL ENGINEERS, at 6.—C. J. R. Williams: The Development of Lyttelton Harbour, New Zealand.—R. F. Hindmarsh: Tyne Commission Quay, North Shields.—R. C. Bristow: Cochin Harbour Works.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Dr. W. Payman: The Applications of Photography in Explosives Research.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. W. W. Drysdale: Marine Salvage Pumping.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch—Graduate Section), at 7.30.—J. Walton: Some Large Span Modern Bridges and their Erection.
BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.15.—Marion Milner: Some American Approaches to the Study of Temperament.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—F. W. H. Migeod: Primitive Pictorial Art in Africa at the Present Day.
WEST KENT SCIENTIFIC SOCIETY (Annual Meeting) (at Wesleyan Hall, Blackheath), at 8.30.

WEDNESDAY, FEBRUARY 26.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Discussion on The Present Position of Distemper Inoculation.
EUGENICS SOCIETY (at Royal Society), at 5.15.—Dr. B. P. Wiesner: Hormones controlling Reproduction.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—S. E. Hollingworth: The Glaciation of Western Edenside and Adjoining Areas, and the Drumlins of Edenside and the Solway Basin.
LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, 24 Dale Street, Liverpool), at 6.30.—W. Hinchcliffe: Some Data relating to Modern Ships' Performance in Service.
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—L. H. Pomeroy: The Double-Six Engine.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—L. C. Burrill: Some Notes on Stability.
HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—J. Hill: Calculations as applied to Weaving.
ROYAL SOCIETY OF ARTS, at 8.—Prof. F. A. E. Crew: Genetical Methods of Live Stock Development.
BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8.30.—Dr. M. D. Eder: On the Psychology of Values.

THURSDAY, FEBRUARY 27.

KING'S COLLEGE ENGINEERING SOCIETY (at King's College), at 5.15.—B. C. Mathieson: Modern Practice in the Manufacture of Portland Cement.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. B. S. Haldane: Some Problems of Genetics.
UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY (at Royal Veterinary College), at 5.15.—H. M. Batten, J. H. Driberg, and others: Public Discussion on The Problem of Trapping.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—R. W. Bailey: Creep of Metals at High Temperatures.
ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 7.45.—A. J. Rowledge: Latest Developments of Aero Engine Practice.
INSTITUTION OF WELDING ENGINEERS (at Caxton Hall), at 7.45.—J. Ryder: The Training of Operators in the Welding and Cutting Industries.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Racing Seaplanes (Lecture).
ROYAL SOCIETY OF MEDICINE (Urology Section) (at Liverpool).
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—S. Sugden: Higher Valencies and the Parachor.
INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd., Manchester).—Short Papers.

FRIDAY, FEBRUARY 28.

ELECTRICAL ASSOCIATION FOR WOMEN (at 46 Kensington Court), at 3.—L. L. Robinson: Tariffs.
ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 5.—Sir Leonard Rogers: Further Experience in Forecasting Epidemics in India and their Bearing on the Reduction of Cholera Epidemics.
PHYSICAL SOCIETY (at Imperial College of Science), at 5.—C. H. N. Lock: The Equations of Motion of a Viscous Fluid in Tensor Notation.—W. L. Watton: A New Type of Dewar Flask, for Use as a Calorimeter.—R. O. Cherry: Field Intensity Measurements around some Australian Broadcasting Stations.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—J. Rowcroft: The Design of Dynamos for Automobiles.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. I. Taylor: A Tour in the East Indies.
INSTITUTION OF ELECTRICAL ENGINEERS (West Wales—Swansea—Sub-Centre).—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.

SATURDAY, MARCH 1.

GEOLOGISTS' ASSOCIATION (at Museum of Practical Geology, Jermyn Street), at 2.30.—C. P. Chatwin: Demonstration of The Palæontology of the Reigate Sheet.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Rothenstein: Nineteenth Century Painting in France and England (2).
MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Prof. W. M. Roberts: Energy and some Points in Statics.
GILBERT WHITE FELLOWSHIP (at Queen Square, W.C.1), at 3.—Conversazione and Exhibition.

PUBLIC LECTURES.

FRIDAY, FEBRUARY 21.

KING'S COLLEGE, at 5.30—Sir Rennell Rodd: Survivals of Ancient Myth in Modern Greek Folk-lore.
SURVEYORS' INSTITUTION, at 5.30.—R. A. Watson Watt: What is wrong with Wireless? (Lecture in connexion with Institution of Professional Civil Servants.)

SATURDAY, FEBRUARY 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Sanctuary in the Middle Ages.

MONDAY, FEBRUARY 24.

KING'S COLLEGE, at 4.30.—Prof. E. Prestage: Portuguese Voyages of Discovery and Empire-Building. (Succeeding Lectures on Mar. 3, 10, and 17.)
UNIVERSITY OF LEEDS, at 5.15.—Dr. J. Chadwick: Nuclear Physics.

WEDNESDAY, FEBRUARY 26.

UNIVERSITY COLLEGE, at 5.30.—K. G. Hunt: The Librarian's Problem of Catering for the Student.
BELFAST MUSEUM, at 8.—C. R. Nodder: Soap Bubbles.

FRIDAY, FEBRUARY 28.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (Department of Mathematics), at 5.30.—Prof. C. Størmer: The Mathematical Theory of the Polar Aurora. (Succeeding Lectures on Mar. 5 and 7.)
UNIVERSITY COLLEGE, at 5.30.—Prof. E. Gilson: L'Idée de Dieu dans la Philosophie de Descartes. (Succeeding Lecture on Mar. 3.)

SATURDAY, MARCH 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: The Solomon Islands and their People.

CONFERENCE.

FEBRUARY 28 AND MARCH 1.

ASSOCIATION OF TECHNICAL INSTITUTIONS (at Skinners' Hall, Dowgate Hill, E.C.4).

Friday, February 28, at 10.30 A.M.—Lord Eustace Percy: Presidential Address.—C. R. Keene: The Relationship between the Teaching of Art and Technology.

Friday, February 28 (*afternoon*), and *Saturday, March* 1 (*morning*).—F. W. Goodenough: The Teaching of Salesmanship in Technical Colleges.—G. H. Gater: A Descriptive Account of Technical Education in London.—E. Salter Davies, Sir Percy Jackson, and Principal J. H. Everett: The Raising of the School Leaving Age and its Effect upon Technical Education.—Principal R. S. Clay and others: Discussion on Technical Education for the Plumbing Trade, with Special Reference to the Rural Apprentice.