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Industrial and Business Administration

BEHIND the growing attention which is focused in these days on planning as an integral element in industrial revival or in national and international recovery, there is an increasing consciousness that the demands which are habitually made on leadership, whether of industry or of the State, are far more onerous than those of a few decades ago. It is not sufficient now for an industrial administrator to be competent to assess merely the internal and local factors of his industry. Whether they are financial, economic, political, or technical, he is compelled to extend his view to the national industry as a whole, and beyond that to an increasing extent to the industry as a world unit. Indifference to the international aspects of industry, like neglect of the technical and scientific factors, invites disaster, and this is as true of national administration as it is of industry. It would be difficult to name a single first-class problem with which modern political administrators are confronted which does not involve in its solution intricate and essential technical and scientific factors which cannot be appraised apart from scientific and technical knowledge.

As we have repeatedly urged in these columns, both industry and the State have in Great Britain suffered too much in the past from administrators whose deficiencies in scientific outlook and knowledge rendered them incapable of maintaining an adequate scientific staff, or of accepting an adequate and sustained programme of research as a fixed charge, comparable with insurance, depreciation, or obsolescence, and incorporating its results in industrial practice. In industry, however, this tendency is passing. The successful development of the newer industries such as those concerned with electrical equipment, automobiles and aviation, or the manufacture of synthetic products such as rayon, resins, etc., which has been primarily dependent upon research and the application of the results of scientific and technical investigation in commercial practice, has involved the organisation of close co-operation between administrators and controllers of policy and those responsible for research and other technical matters. The increasing authority and prestige of the technical expert in such industries is now extending to older industries, as may be seen in the appointment of an eminent man of science to direct and co-ordinate all research for the London Midland and Scottish Railway, an appointment carrying a status corresponding to that of the principal directing heads on the administrative side.

As a result of these developments in industry, there has thus been a considerable change from the control of industry by those whose chief qualifications are financial and commercial to control by boards of directors which collectively combine the knowledge of finance, general organisation, administrative problems, and the trend of scientific and technical developments requisite for wise and far-seeing decisions on general policy. To this process the merging of industrial undertakings for the purposes of technical rationalisation has given a further impetus. Much of the wider and more urgent interest in management problems is derived from the rationalisation of industry. In fact, it may be said that the brief history of rationalisation in the world has already convincingly demonstrated that the success of a rationalisation policy is bound up inseparably with leadership competent to evaluate accurately all the relevant factors involved, whether scientific, technical, financial, or commercial. It is probably deficiencies in one or other of these respects, and consequent failure, that has led to suggestions that efficient administration of some of the largest international mergers is a task beyond human powers. Authoritative inquiry has, however, failed to reveal any evidence of such inherent limitations on human ability, and public opinion is gradually becoming sufficiently enlightened to perceive the true cause of such failures as lying in those who insist on discussing questions and policies involving technical or scientific considerations without the assistance of the appropriate experts.

Evidence of this change in the attitude of industry, and indeed of public opinion, can be found in the progress of such diverse institutions as the International Management Institute with its associated Management Research Groups, the Institute of Industrial Administration, which aims at establishing industrial administration as a recognised profession, as well as in the inclusion of a discussion on scientific management problems in the programme of Section F (Economics) at the centenary meeting of the British Association last year.

Among these, one of the most interesting experiments is the Department of Business Administration at the London School of Economics and Political Science.* Established in 1930 through the joint efforts of leading business firms and school authorities, and financed mainly by business subscribers, the Department of Business Administration provides selected students with full-time training in the broad principles of business administration, as well as, where necessary, giving a preliminary general economic training. The Department does not aim at large numbers of students but at giving personal attention to a limited number each of whom has given evidence of an adequate general education and of personal qualities likely to make them suitable for a business career. The primary object of the training is to develop the quality of judgment and the breadth of view required for solving the practical problems which are encountered in business life. A secondary object is to provide a background against which the students can place the problems they afterwards meet.

With these objects in mind, instruction is carried on mainly by means of small discussion classes, including what is known as the problem or case method, supplemented by written work. Material supplied by business firms and illustrating the actual problems of business life is used in class discussions. In addition, the systematic investigation of business problems, organisation, and methods, mainly from the point of view of the individual concern, forms an integral part of the Department's work, and in time the Department hopes to cover a number of the major fields of business activity, although its present plans are limited to the study of certain aspects of marketing and business finance. In the latter field an investigation has been undertaken on the financial structure of business with the object of ascertaining whether normal forms of capitalisation exist for different types of business.

The Department of Business Administration is thus a definite attempt to meet the need for business training which is at present so ill provided for. Obvious criticisms can be made of its aims and methods, but it is not suggested that the course can do more than assist the formation and development of habits of judgment which will mature in actual experience of business and industrial life. The training provided by the Department has new advantages in the extent to which it renders available for the coming generation of administrators the experience of many firms of varying sizes and in different branches of industry or commerce. The breadth of experience thus offered is far greater than could be acquired in any one firm, apart from the practical difficulty which would be encountered in a firm of any size in the student acquiring experience by working his way through the different departments of the firm.

The scheme of training thus briefly outlined is an

* The London School of Economics and Political Science (University of London), Houghton Street, Aldwych, W.C.2. Department of Business Administration, Session 1932–33. Pp. 28. Training for Business Management. Pp. 11. (London, 1932.)

experiment which is still developing and has not reached its final form. It can be justly claimed for this novel attempt to meet the need for fresh methods of recruiting and training business administrators for the future which arises from the changed economic conditions of the world, that it is based on a closer co-operation of academic and business authorities than has hitherto been achieved in Great Britain, and without abandoning any academic standard it seeks to base training for business upon business. It should not be too much to hope or expect that training along such lines will assist in the development not of scientific management as a restricted profession, however efficient, but in the provision for industry and the State alike of administrators versed in tried principles of administration and competent to assess the technical and scientific factors entering into problems they are called upon to solve. A generation of such administrators in government service and in industry would speedily ensure that the scientific expert took his rightful place in the business or mechanism of government in industry or in the State.

Inevitably, administrators of the required standard will only be forthcoming if the recruits for such courses are drawn as freely from scientific workers as from those who have graduated in arts or law or economics, and if the government service is at present lamentably behind industry in the scope it affords for administration by those having first-hand knowledge of science, the present tendency towards functional representation will ultimately make it easier for industry to influence State administration in the same direction. The firm establishment of the expert and the expert committee in industrial administration, and the proof of the scientific worker's competence to meet the searching demands of administration in an industrial merger on an international scale, should finally result in the scientific expert taking a corresponding part in the machinery of national and international government. Already the value of the expert committee has been demonstrated in the international sphere, and it behoves the scientific worker to watch with great interest all such experiments as that of the Department of Business Administration which seek to raise the standard of industrial administration or to promote scientific management, and to lose no opportunity of qualifying himself to discharge more efficiently those administrative functions from which in the present age he cannot escape, if industry and society alike are to avoid disintegration.

Matter and Conceptions

The New Conceptions of Matter. By Prof. C. G. Darwin. Pp. viii + 192 + 6 plates. (London: G. Bell and Sons, Ltd., 1931.) 10*s.* 6*d.* net.

IN this book the author aspires to a popular account of the recent developments of atomic physics—in particular, that aspect of it which is known as 'wave-mechanics'.

"I believe [he writes of his presentation] that it makes a consistent formulation of the foundations, which only needs the help of mathematics to yield all the results of the theory so far obtained. However that may be, I have little hesitation in saying that, if it is to be at all possible to present the new mechanics in popular or even semi-popular terms, it must be done more or less on the lines I have adopted here."

Speaking broadly, the method referred to may be described as that of giving a familiar physical interpretation to the mathematics of the subject. Since the mathematics does not on the whole lend itself to very obvious interpretation, this leaves considerable scope for the ingenuity of the expositor, and Prof. Darwin's chief difficulty has been to interpret the equations in the most 'natural' way.

"I shall count myself as having succeeded [he writes], if at the end of the book any surviving reader will speak no longer of the mysteries of science, but, shall we say, of the naturalness of Nature."

It may be said at once that, if we admit the legitimacy of the aim, the task could scarcely have been performed more satisfactorily, and many a student of advanced physics will call Prof. Darwin blessed. Every such student should read the book, for it provides him with what he will not obtain elsewhere with the same completeness and general excellence; namely, an approach to the incomprehensible mathematics of the subject by way of the physical counterparts of equations in more familiar branches of physics.

The account of the diffraction of electrons, the real starting-point of the book, is prefaced by some seventy pages of introductory matter dealing with fundamental physical conceptions, wave motion, and the principle of least action. As an interpretation of the new experimental facts we are introduced at once to the uncertainty principle and the duality of wave and particle, and in the light of these basic conceptions the structure and behaviour of the atom, polarisation of waves and particles, collisions between particles, and the exclusion principle are successively discussed. The

treatment is well conceived, clear, and very interesting, and it is difficult to see how in its general features it could be improved.

If, however, we consider the book not 'as in itself it really is' but in relation to its object, we can only describe it as a magnificent failure. Success, indeed, seems to us impossible, for it presupposes a reading of the lessons of modern physics which we cannot accept. To Prof. Darwin, mathematics (or, as we prefer to say for the sake of generality, logic) is the scaffolding by which physical models are erected, and his task is to remove it and reveal the structure.

"The new discoveries which I am to describe were only begun five years ago, and so it is hardly surprising that they are still partly covered with the scaffolding of mathematical formalism. But I hope to show that the time has already come, when it is possible to free the structure from a good deal of this scaffolding and so to gain something of an intuitive view of what the world is really like."

What are the facts? Simply that until lately there has always been a one-to-one correspondence between the concepts of atomic physics and objects of experience, but that the latest concepts have no empirical correlatives. Prof. Darwin's view is that such correlatives exist and we have to find them; if he is right, then his aim is capable of fulfilment. But it is a possible interpretation that the whilom correspondence was a merely superficial characteristic, and that its breakdown is not a temporary inconvenience but an indication that in our investigations of the relations between phenomena we have got below the surface. If that is the truth, then Prof. Darwin sits in the chair of Cnut.

It is, of course, a matter of opinion at present, and Prof. Darwin's opinion is entitled to as much weight as another's. We cannot, however, think that his book will lend it much support. If anyone, on reaching the end, speaks of the 'naturalness of Nature', it will be in the hushed tones due to departed majesty. More than once Prof. Darwin finds it necessary to apologise for the imperfection of his descriptions of ideas "which are mathematically fairly easy", whereas, we think, he should have apologised for their success, because in so far as they succeed they are of necessity misleading. A great part of the book is, of course, concerned with the view of the electron as a wave, but if the reader asks, 'A wave in what?', he will find no answer unless he wrongly, but perhaps excusably, interprets pp. 22-23 as replying, "Waves in the luminiferous ether". He may succeed in realising that the wave and particle aspects of the fundamental concepts are not contradictory but complementary, but he will not discover why they should both exist or how they can be unified. The only answer provided to the old query why one aspect is presented on Monday, Wednesday, and Friday, and the other on Tuesday, Thursday, and Saturday, is that one day does not overlap another. This falls somewhat short of "an intuitive view of what the world is really like".

It is questionable whether even some of those who admit the unpicturability of modern physical concepts have realised the revolution which it causes in the principles of popular exposition. We speak of 'wave mechanics', and thereby introduce a completely false idea. When an elastic solid ether was the orthodox belief, it was permissible to speak of waves in the ether just as one spoke of waves in water. The two waves were not merely interpretations of the same equations; they were physically identical interpretations. But an electron and a water wave are not physically identical, and it is as misleading to call an electron a wave as to call a water wave an electron. Our language has suddenly become figurative, and it is not realised that in using it for the uninitiated the impression made is as if, for example, we claimed that the unliberated content of Pandora's box was Watts's well-known picture because both are represented by the symbol 'hope'. Men of science have turned poets, and the public takes their metaphors literally.

If, however, we are prepared to swallow this camel, Prof. Darwin provides us with very few gnats to strain at in the way of incidental analogies. This is one of the most pleasing features of his book, and it is therefore extremely unfortunate that one of the few analogies which are introduced should be a particularly bad one and should deal with a particularly important point. The wave and particle aspects of the electron are likened respectively to the objective and subjective aspects of a sound or colour because of their absolute separation but interdependence. The question of analogy in popular description is so vital and so consistently neglected that it might not be out of place to give it a brief general consideration here.

It is easy to prove that an analogy is at best worthless and at worst misleading. The analogue, not being identical with the point to be illustrated, has certain relevant and certain irrelevant elements. If the reader does not already understand the point in question he has no means of distinguishing between them, and if he does understand it the analogue is superfluous.

Actually the human mind gets round this logical obstacle by virtue of the fact that certain previous experiences spontaneously spring to mind when the analogue is mentioned, and these are accepted as the relevant elements. It follows that a successful analogue will be one of which the relevant elements really are those which will thus spontaneously occur to the reader. Thus, the solar system was, on the whole, a successful likeness to the Rutherford atom ; it led no one to think of electrons as abodes of life, though, it is true, a student might have conceived of them as rotating bodies before there was justification for that idea. The outstanding fact of the solar system, however, is the revolution of satellites round a central mass, and the analogue was a good one because that was the relevant element of it.

Prof. Darwin's analogy, on the other hand, is a bad one, because the contrast between ' subjective ' and ' objective ' will be immediately interpreted, by most readers at least, as a contrast between something existing in the ' mind ' and something existing in the ' external world '. Just as a deaf person will have no subjective experience of the ' middle C ', but may yet know all about its objective aspect through mechanical experiments, so —the reader will imagine—he himself might, by physical injury, lose the power of detecting the particle aspect of an electron, but retain intact his appreciation of the wave aspect. He will then wonder why the particle aspect is introduced into the scientific description at all, and if he has chanced to hear elsewhere that Heisenberg and Bohr, with reference to a different point, have claimed to show that subject and object are inextricably interwoven in physical theory, he will be fairly caught in a net of confusion into which Prof. Darwin's habitual clearness of expression, so far from delivering him, will only draw him the tighter because of his unwillingness to believe it to have failed. It is much to be hoped that in future editions this objectionable illustration will be removed.

Prof. Darwin more than once, and rightly, insists on the principle that ' unobservables ' must be expelled from physical discussion. This is undoubtedly the great contribution of modern physics to thought in general. It is of the first importance, therefore, that it should be stated precisely, and this unfortunately is not done. We refer not so much to the statement (p. 81) that " if a thing is essentially unobservable then it is not a real thing ", which might lead to misunderstanding among those whose definition of reality is not that of the physicist, as to the discussion on p. 156 which culminates in the remark :

" It is meaningless ever to ask what has happened, unless there is either a direct or an indirect observation to tell one ; and if there is an observation it is pointless to ask, because one knows the answer."

The necessary conclusion is that in no circumstances is it anything but futile to ask what has happened. The true point of the principle is that events which cannot *conceivably* be observed, owing to their relation to the processes of observation, are taboo, and that is a very different thing. It allows us, for example, to discuss the far side of the moon, which on Prof. Darwin's principle is illusory.

The book is well produced, and contains several original diagrams. HERBERT DINGLE.

Fashions in Deformity

Artificial Cranial Deformation : a Contribution to the Study of Ethnic Mutilations. By Dr. E. J. Dingwall. Pp. xvi + 313 + 54 plates. (London : John Bale, Sons and Danielsson, Ltd., 1931.) 70*s.* net.

ONE of the strangest eccentricities in human behaviour is revealed in the widespread practice among even civilised men and women of bodily mutilations, such as scarring and tattooing, piercing ears, noses, lips, or tongue, circumcising, knocking out teeth, compressing the feet, amputating fingers, compressing the waist, and distorting the head. These procedures are so devoid of rational justification and so destructive of the natural beauty of the human form that it is difficult to discover any plausible excuse for their invention. Hence the geographical distribution of such deformities affords valuable evidence in support of claims for the diffusion of culture in early times.

Obviously it is a matter of importance to submit the evidence relating to each of them to the most critical and exhaustive study to discover whether in fact they do throw any decisive light on theories of diffusion or independent development. Dr. Dingwall has performed the onerous task of collecting and setting forth the facts relating to the practice of deliberately deforming the heads of children so as to confer upon them more or less the fantastic and unnatural shapes which fashion dictates for the aristocracy of certain peoples. He has refrained from drawing conclusions : he has attempted to cite the evidence with complete impartiality, without neglecting, however, the important matter of recording the associated customs and beliefs. Although he cites nearly 1200 memoirs

and treatises, he modestly disclaims regarding this list as an adequate bibliography.

Writing in 1915 of the diffusion of culture, I directed attention to the fact that the practice of cranial deformation was intimately associated with the megalithic complex, and tentatively suggested that the distortion of the head may have been first invented in Asia Minor and secondarily associated with the custom of building rude stone monuments in the course of its diffusion. The observations of Dr. L. H. Dudley Buxton, the results of which were given verbally to Dr. Dingwall (and since published, in part, in the *Anthropologischer Anzeiger*, 7, p. 236; 1931), establish the fact that the earliest actual examples of artificially distorted skulls so far recovered come from Crete and Cyprus. They belong to the period of "the late Minoan III., when Bronze Age Cretans had a lively trade with Egypt". From this period in Egypt there have been recovered several busts of Akhenaten's daughters (1360 B.C.) displaying extreme forms of the same intentional cranial deformation; and in the pictures of the Heretic King himself and of his Queen a less extreme form of the same peculiarity is suggested. In spite of the doubts which have been expressed, it is beyond question that Akhenaten's portraits reveal pathological changes, which afford a measure of justification for his artists' fantastic exaggeration of his peculiarities. Whether or not this fashion in mutilation began from an imitation and exaggeration of Akhenaten's natural affliction it will be impossible to decide until authentic skulls of the period have been found. Yet there is positive evidence that about the same time artificial deformation was being practised in Crete and Cyprus.

Dr. Dingwall gives fully documented evidence of its practice in past and present times in Europe, Africa, Asia, the Malay Archipelago, Melanesia, Polynesia, and especially in North and South America, including descriptions of the technical methods employed to effect the mutilation. "We may well ask", he remarks (p. 237), "with Quatrefages whether it is coincidental that the deformed skulls of the Caucasus, France, and America are so similar." "Writing in 1889 he (Quatrefages) says that it is indeed difficult to admit that the idea of deforming the human head in such an extraordinary way has been independently evolved in each of those peoples where we see its manifestations." Quatrefages adds: "one is forced to admit evidence both of diffusion and the contact of cultures". Dr. Dingwall thinks that this opinion "is not to be passed over lightly. The custom of cranial deformation is not uniform in all parts of the world. It cannot be the response to some innate human impulse. Confining the custom almost exclusively to a certain class suggests that the idea is either derived from, or connected with, some notion concerning differences between aristocracy and commoners."

In the laborious task of collecting and setting out the enormous mass of data concerning one of the strangest eccentricities of human fantasy, Dr. Dingwall has rendered a conspicuous service to all students of human history. The book is well illustrated with photographs, drawings, and maps. It should be included in every library concerned with anthropology or the vagaries of human inventiveness. G. ELLIOT SMITH.

British Beetles

A Practical Handbook of British Beetles. By Norman H. Joy. In 2 volumes. Vol. 1. Pp. xxvii + 622. Vol. 2. Pp. 194 (170 plates). (London: H. F. and G. Witherby, 1932.) 63*s*. net.

A DESIDERATUM of long standing was a reasonably priced manual on British Coleoptera. The standard work by Fowler, and especially its illustrated edition, is beyond the means of most students and collectors of insects. In supplying this want, Dr. Joy has set himself the difficult task of dealing in a limited compass with a fauna of about 3560 different species. He approaches his subject with a background of wide experience as a coleopterist, and with a keen appreciation of the difficulties, which especially beginners encounter, in the identification of so many of the species of the order. He has, therefore, written what is essentially a manual of identification for the use of collectors.

The subject matter is arranged in the form of dichotomic keys: first, keys to the superfamilies (or suborders, as the author terms them), then keys to the families of each, and so on down to the genera and species. His principle is to select diagnostic or critical characters, so far as possible, in each series of keys, and so avoid detailed technical descriptions. Ample cross-references to text and plates are given, and much space is saved by the use of abbreviations for frequently recurring terms and for indicating distribution. The essential letterpress fills vol. 1, while vol. 2 consists of 169 plates portraying species and structural details in more than two thousand separate figures. These latter are, for the most part, original, and are reproduced as clear line illustrations. With the aid of these two volumes, the process of identifica-

tion has been reduced to the limits of simplicity, without, it is to be hoped, undue sacrifice in other directions.

In the taxonomic arrangement of the book, convenience takes precedence over orthodox scientific sequence. Thus, the work begins with the Brachelytra and ends with the Clavicornia. The nomenclature followed is mainly that of Heyden, Reitter, and Weise (1906). Here possibly difference of opinion may arise as to how far this system is sufficiently modern for certain of the groups.

Viewed as a whole, it may be said that the author has carried out his task extremely well. His unconventional treatment may annoy purely scientific users, but it has definite advantages. We think that the beginner, more especially, will prefer Dr. Joy's volumes to any others, and for that reason they will impart fresh stimulus to the study of British Coleoptera. The two volumes are excellently produced: the paper and binding are good and the type large and clear; misprints are few. Mention must also be made of the very efficient indexes. The book deserves every success, and if regular usage proves it to be accurate and reliable we think that its success will be assured.

A. D. IMMS.

A Plain Man and a Mystic

(1) *Rural Rides*. By William Cobbett. Pp. xiv + 363. (2) *A Week on the Concord and Merrimac Rivers*. By Henry Thoreau. Pp. viii + 361. (Open-Air Library.) (London and Toronto: J. M. Dent and Sons, Ltd., 1932.) 3*s*. 6*d*. net each.

A FOREWORD by Mr. Fitch Daglish introduces us, in friendly fashion, to Cobbett and to those "Rural Rides" of which he wrote in his *Weekly Register*, a hundred years ago. He was sorely troubled by the "distressed state of the agricultural interest", all due (or so he says) to the "desolating and damnable system of paper money"; and this and what more he has to say on taxes and national debt sounds familiar to us, now that we are down again after a hundred years in the trough of an economic wave: "The system", he says, "seems to have fairly wound itself up; to have tied itself hand and foot with cords of its own spinning".

Cobbett was a good knowledgeable farmer, and his remarks on the farms by which he kept riding are vigorous and original. He always knew the soil below by the crops above, and badly farmed land or ill-kept cattle roused his contemptuous indignation. Courageous and prejudiced, he had that most useful political weapon, a knack of finding the appropriate and opprobrious epithet; and he seemed to have a personal interest in every cultivable inch of English soil. He was more than sixty years old when he rode those rural rides of his in all weathers, on a horse after his own heart, "tall, strong, gentle, and bold". He rode through villages and towns (or "wens", as he is fond of calling them) from Hants to Northumberland, welcomed everywhere by those "good and sensible men" who took in the *Weekly Register* and rang the church bells when he arrived. His many digressions are pointed and lively. He hates the agricultural monopolist, "the great bull-frog who takes all", neither more nor less than the city "tax-eaters and such vermin"; he loathes the teaching of the "barbarous and impious Malthus"; he has a pithy phrase always ready to hand, such as "a poor spewy gravel"; he admires the public spirit and political instincts of the race of cobblers; and on beholding the Oxford Colleges, he can't help thinking of "the drones they nourish and the wasps they send forth".

Cobbett's reaction to Nature was that of the eighteenth century, that of a disciple of Swift and of Voltaire. He thinks little of birds or of flowers; his interest lies with trees, and with those which are most useful to mankind. The unkempt but lovely larch "is fit only for burning". He was not insensible to beauty, but his appreciation of the country landscape was direct and agricultural. His spirit found freedom and well-being in the open air; and the familiar sights of farm and field, dear to him from childhood, stimulated his lively and curious intelligence to express itself in clear, easy, and trenchant prose.

Thoreau's "Week on the Concord" is another famous book of the open road, but its spirit is altogether different from that of the "Rural Rides"; it reflects the clean-cut and remarkable change of mood which is known as the romantic revival of the mid-nineteenth century. The two authors wrote under different inspirations, and besides, they were two very different men. Cobbett was a natural, warm-hearted, lovable, and exasperating man, with the reformer's aggressive sense of injustice, and with the usual accompanying touch of human vanity. Thoreau was a prig, self-conscious and philosophical; but his love of Nature and of books was genuine enough, if a trifle undiscriminating. He was a better naturalist than Cobbett and could write very pleasantly; but he was guilty now and then of execrable phrases and offensive sentimentality. Between the two men we become aware of

one of those complete changes of temper and of outlook which happen now and then in history. Human mentality itself seems to break down in a sort of emotional 'histolysis'; and the new generation can scarcely speak or understand the language of the generation before.

If we love quaint pieces of local history, scraps of folklore, and rambling disquisitions on philosophy, we may find them all in Thoreau. The angler will love his intimate pictures of "our finny contemporaries"; his leisurely descriptions of banks and woodlands will charm many a reader. The older naturalists of the countryside, lovers of the hedgerow and the open road like Cobbett and Thoreau, have been out of fashion for a while; and these pleasant books introduce us to them again.

L. STARKE.

Short Reviews

Men of the Trees: in the Mahogany Forests of Kenya and Nigeria. By Richard St. Barbe Baker. Pp. 283 + 31 plates. (London: George Allen and Unwin, Ltd., 1932.) 12*s*. 6*d*. net.

CAPT. BAKER is a forestry officer, not an anthropologist; yet his story of how he enlisted the services of the natives in conservation and afforestation work is an object-lesson in the practical application of knowledge of native custom and psychology to a problem in which the practice of the indigenous inhabitant ran counter to the end which the administration had in view. Probably Capt. Baker's object could not have been attained in any other way. An order framed to constrain native action might have been ignored or even disobeyed; and, in any event, it would almost certainly have led to friction.

From time immemorial, native methods of agriculture have been destructive of the forest. Small clearings are made, by fire and the machete, which are cultivated for a short time and then abandoned. The group—family or tribe—then moves on to another patch, and the process is repeated, the trees which have been destroyed not being replaced by planting. Capt. Baker secured the co-operation of the natives in his work of repairing the damage, and averting it in the future, by an appeal to their love of festivals and ceremonial dancing and their desire for social distinction through membership of a secret society or esoteric group. He formed a band of 'Men of the Trees', to which only the elect were admitted, pledged to plant and protect trees everywhere, distinguished by insignia, and owning its own special dance. Of its success we may leave the author himself to tell; but lest it may be thought that his story weighs as much against as for an anthropological training, as he was not an anthropologist, we hasten to add that his sympathetic understanding of the native is of an exceptional calibre.

This is indeed no scientific treatise on the forest trees of Kenya; but it may serve to spread among the general public a knowledge of the potential wealth of the timbers of the country if administered with care and skill.

The Taylor Series: an Introduction to the Theory of Functions of a Complex Variable. By P. Dienes. Pp. xii + 552. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 30*s*. net.

A POWER series of the form $\Sigma a_n(z-z_0)^n$ which converges at more than one point, converges inside a circle centre z_0 and coincides with the series obtained by applying Taylor's theorem to the sum-function. If another point z_1 is taken inside the circle of convergence, the function can be developed in a series $\Sigma b_n(z-z_1)^n$, which also converges inside a circle centre z_1, the area of which may extend beyond that of the original circle of convergence. An analytic function is defined by the original series and all possible transformed series obtained in this way. Since the coefficients b_n are obtained uniquely from the coefficients a_n it follows that the whole behaviour of the function must be determinate when the sequence of coefficients a_n is known. The problem of Taylor's series is therefore to deduce from a knowledge of the coefficients the behaviour of the function.

The first seven chapters of this book give the elementary properties of functions of a complex variable, ending with Jordan's theorem and a rigorous proof of Cauchy's theorem. These chapters are furnished with a variety of exercises. Chap. viii. discusses biuniform mapping and the theorems of Bloch, Schottky, Landau, and Picard. Chap. xi. deals with various means of representing a one-valued analytic function by an explicit formula. The problem of uniformisation is not discussed, as being beyond the scope of an introductory treatise. Chap. x. considers singularities and Chap. xi. overconvergence and gap theorems. Chap. xii. on divergent series gives a welcome and systematic discussion of generalised limits and sums. In Chap. xiii. this theory is applied to the Taylor series on its circle of convergence. Chap. xiv. discusses the relations between singularities and divergence.

The whole book forms a very useful introduction to the theory of functions of a complex variable, and the author is to be congratulated on the manner in which he has systematised such an immense amount of material in a way which is calculated to give a proper perspective of the subject. The printing is good, but the numeration of the paragraphs is not sufficiently prominent for easy reference.

A Manual of Beekeeping: for English-speaking Beekeepers. By E. B. Wedmore. Pp. xxiv + 413 + 8 plates. (London: Edward Arnold and Co., 1932.) 15*s*. net.

IN 1563, Thomas Hill wrote "A profitable instruction of the perfite ordering of bees". Since that time the stream of manuals for the use of English-speaking beekeepers has been continuous. The present work is intended as a practical handbook

for use in the apiary and is conveniently arranged for this purpose. To avoid needless repetition, cross-references are freely used, but not in such a way as to become exasperating.

The author has been wise in leaving matters of anatomy and physiology to books primarily devoted to those subjects. He is at his best when giving directions for the carrying out of some operation of practical beekeeping. His instructions are precise and to the point, and much of the information given is most conveniently tabulated. 'Manipulation' is a word beloved by beekeepers, and if a tithe of the operations here detailed were carried out, beekeeping would cease to be profitable, but the author gives us a timely word of warning: "*The skilled beekeeper is known by the small number and apparent simplicity of the manipulations he employs*". (The italics are his own.) Nevertheless, the directions for dealing with an emergency when it arises are to hand in these pages. The sections dealing with biological matters such as the underlying principles of swarming and the causes and diagnosis of bee diseases are less happy; while the lists of honey plants are necessarily sketchy and compiled from other sources.

The information given is intended to be generally applicable, and an attempt has been made to do justice to the conditions and practices of the honey-producing regions of Canada, New Zealand, and Australia.

The volume is singularly free from the expression of pet theories and prejudices such as mar so many books on bees. The figures are good and illustrate points in the text. The binding is of a practical and durable type, as it will need to be if the book is to be used in the way that is intended.

D. M.

Borstalians. By J. W. Gordon. Pp. 284. (London: Martin Hopkinson, Ltd., 1932.) 7*s.* 6*d.* net.

THIS is an interesting, useful, and on the whole well-written book. It appears at a time when outbreaks of crime, especially in the United States and to a certain extent in England, have made methods of prevention even more urgent than methods of detection and punishment. Mr. Gordon reveals with intimate knowledge and sympathy the methods employed now for a good many years at the five Borstal institutions in England. It is an encouraging picture, and being drawn with a frank and critical hand, carries the more conviction. He was himself an inmate at the Feltham Borstal and, having made good afterwards, largely through the interest and generosity of an American friend, was able to revisit the scenes of his early training, recall his own experiences, and note subsequent changes. He also visited the girls' Borstal at Aylesbury, and seems to have marched with the new colony which swarmed off a year or two back from Feltham to Lowdham. This forms one of the most attractive episodes in the book.

Criticising his own criticism, one is inclined to ask whether more might not be done in the way of stimulating intellectual interest, encouraging reading and providing classes and lectures, as well as the excellent work done by sports, games, badges, houses, etc. The girls seem to be better looked after in this respect. Perhaps women generally are less inclined to be frightened by the damning appellation of 'highbrow', a word and an idea that are doing a world of mischief. F. S. M.

Breeding and Care of the Albino Rat for Research Purposes. By Milton J. Greenman and F. Louise Duhring. Second edition. Pp. 121 + 6 plates. (Philadelphia: The Wistar Institute of Anatomy and Biology, 1931.)

THIS book gives a clear and detailed description (with diagrams) of the housing, feeding, and behaviour of a colony of rats which has been in existence at the Wistar Institute for some twenty-four years. Thus the various points recommended are the result of much experimenting and long experience, which make them of real value, though some of the arrangements for housing appear to be unnecessarily elaborate. In addition, details of cages and water vessels, etc., in use and found suitable in other laboratories are given. Chapters on the parasites and diseases specially likely to attack the albino rat are also included. Special stress is laid on the advantages of 'gentling' the rats by frequent handling and of giving them opportunities for exercise, a point too often overlooked in breeding rats for experimental purposes. The importance, too, is emphasised of making full records of growth and fertility of the colony from time to time, so that any possible deterioration may be rectified.

The book will be of particular value to research workers who are starting a colony of rats, and it cannot fail to interest also those workers who may have a colony already established.

Theory of Simple Structures. By Prof. T. C. Shedd and Prof. J. Vawter. Pp. x + 345. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s.* 3*d.* net.

So many textbooks have been written on the subject of structural statics that it must have become a somewhat difficult matter to find any fresh aspect of presentation. The authors of the present work, however, very properly and consistently emphasise the application of fundamental principles to all constructional problems, and this attitude constitutes the keynote of their treatment. They deprecate merely graphical methods, which "have a tendency to leave the student with the memory of a method of construction and only a vague notion of the principles involved". Certainly, they have produced a very clear and concise exposition of the subject, which students should have no difficulty in assimilating, while the abundance of problems set provides an ample field for testing the knowledge acquired. Written by two American university professors, the purview of the photographic illustrations is largely trans-Atlantic, but the examples are interesting and helpful, while the diagrams generally are very clear and comprehensible. B. C.

The Scope and Needs of Medical Research *

By Sir WALTER M. FLETCHER, K.B.E., C.B., F.R.S.

THE phrase 'medical research' covers an immensely wide field of scientific activity in which workers of many different kinds are occupied. It is concerned directly and indirectly with the welfare of the bodies and minds of human beings, and if properly treated it must be a subject of the first interest to any human audience. The word 'medical' in this relation is likely to mislead. Strictly it refers only to the healing of disease, and it calls to our minds at once a vision of doctors at the bedside and of their drugs or implements. Yet as we use it here it has a scope, not only in the work of original investigation but also in preparing its results for practical application, which is indefinitely wider than that of the healing profession as such.

I can give an actual definition of the real scope of medical research in formal terms. It is a formula which has been adopted by His Majesty's Government to define the field of medical research work to which an annual Parliamentary grant-in-aid is made, and it is in these terms: "Medical research deals with the proper development and the right use of the human body in all conditions of activity and environment, as well as with its protection from disease and accident, and its repair".

Let us take each phrase of the definition in turn. The development of the human body: here we have to consider both nature and nurture, both inheritance and nutrition. Dangerous as it is in scientific studies to separate these sharply in our minds, as is so often done, each, nevertheless, is served by a special scientific discipline. One is served by the science of genetics and the other by the science of nutrition.

The science of genetics is still in its first infancy. By an easy effort of imagination we can form almost illimitable hopes of betterment in body and mind that fuller knowledge in this subject may hold out to the human race. Dreams of this are so attractive and may be so vivid as to tempt us to propose short cuts to make them real. Hasty practical proposals made in the name of what is called 'eugenics' are put forward. Many of these are based on obviously false assumptions, as, for example, that particular parts of the community are not desirable breeding stock, merely because at present they are inadequately fed; or, again, that the qualities which make many men rich are the qualities which we should desire to multiply in our race. Quite apart from witless social prejudices of that kind, the very machinery proposed for attaining the results desired has often no basis at all in scientific knowledge. Yet in this field some of our highest hopes for man's future may still reside. We have evidence already that the knowledge we have gained of the laws and machinery of inheritance in the lower animals holds good for man. Small beginnings are being made already by the studies of selected pedigrees, the use of probability laws, the examination of correlations between characters either directly observable or detectable by refined methods of blood examination—all these give growing hopes of our being able to map out the distribution of factors in the human chromosomes, those minute carriers of inheritance in the parent cells. Medical knowledge has a leading part to play here, for the most hopeful clues now in sight depend upon closer medical study of the inheritance of disease and abnormalities in family history. We are in practice cut off from the method of experimental mating in the study of human inheritance, and must perforce use the methods of medical observation and analysis of pedigrees. The work in sight is vast and may occupy many generations. All the more important then that it should begin early. There is no short cut to the power for human welfare that we may hope some day to gain by genetic knowledge. The only road to this has to be cleared up by persistent effort in this primary branch of medical research.

The other side of the study of the development of man's body, that of nurture, lies in the field of nutrition, and here there is a very different story. This study is concerned in part with the quantitative study of the energy requirements of the body and in part with the qualitative values of diet. It has only been a branch of exact science for the last generation or two. Our knowledge upon the qualitative side, even of the very existence of the vitamins, so familiar by name now to all, belongs only to the last twenty years. Yet from the knowledge so far won in this field we have already gained practical powers of high value. I will return presently to this subject of nutrition to illustrate in more detail the value and interest of this part of the medical field.

Pursuing our definition, we now come, after dealing with the development of the body, to the problems of its right use—and its right use in all conditions of activity and environment. Here we deal with problems of personal hygiene, of sleep, of diet in relation to climate and to bodily activity. We have to deal also with an intricate group of problems belonging to industrial life. The industrial revolution and the introduction of machinery upon a great scale brought a host of new problems under this head. Individual craftsmen throughout the ages have found for themselves their own ways of working to the best effect, and of making the compromises needed for gaining the best output with the least fatigue and damage to health. The introduction of machinery and the gathering of workers into large factories came about with far too much regard to the welfare of the machinery and the magnitude of its output, and with far too little regard to the machinery of the bodies of the workers. The application of physiological knowledge in this field has been lamentably slow in coming. Most of the elementary problems of maintaining efficiency

* Friday evening discourse delivered at the Royal Institution on May 27.

in work and of the spells of rest needed for particular occupations of many kinds have been studied only within the present generation, after almost a century of waste, discomfort, and misery.

The War brought home to us our ignorance of this branch of medical study, though no other country had greater incentive, both in duty and in profit, to lead the way in its development. When the safety of our people depended upon the fullest output of war material and the maintained efficiency of the workers, it was found that we were ignorant, as a nation, of some of the most elementary laws of industrial health. We had to find and apply as best we could the optimum hours of work and the best use of rest pauses for different kinds of work, ranging from heavy physical labour to light manipulative tasks involving maintained attention to rapid machine processes. When the lives of men, or indeed of armies, might depend upon the rapid use of the spade in trench-warfare, it was found that nobody since Adam first used a spade had worked out the optimum rest-pauses for the best performance of a gang of digging men over different periods. Medical research had also to find new safeguards for men living in submarines below the sea, mining far into the earth, or flying to great heights in the air.

During and since the War, a great volume of research work has been done under the Industrial Health Research Board to clear up these problems connected with the right use of the human body. They deal with hours of work, heavy or light, rest pauses, shift systems, the problems of monotony in repetitive work; they have dealt with the human factor in the causation of accidents, with problems of ventilation, of lighting and heating, with all the special problems of vocational guidance and selection, with the study of body movements, posture, and physique in particular industrial processes, as well as with the special dangers arising from poisonous materials in particular trades or occupations.

We now come to the protection of the body from disease, and here we come for the first time to what is ordinarily thought of as medical work in its narrow sense. This part of the work falls, of course, at once under two main divisions. There is the work of preventing disease, and there is the work of curing or palliating disease when already present.

We can scarcely think, and have no reason to think, of disease as being caused otherwise than in one of three ways. There are diseases due to abnormalities of structure or chemical behaviour which are inherited and come from the genetic history of the individual. There are other diseases which are due to faults in the immediate environment of the body, early or late in its development, such as those, for example, known to be the result of imperfect nutrition. Lastly, there is a great variety of disease due to the direct attack upon the body by other forms of life in the shape of parasitic enemies.

We can aim at preventing inherited disease by increasing our knowledge of genetics and by regulating human mating. It will be very long before we have knowledge enough to gain much power in this direction, and how far we can use it when gained will depend upon our political structure and social habits. Already our genetic knowledge is enough to allow us to abolish at once one type of juvenile idiocy and greatly reduce other mental defects by regulation of marriages in the families displaying them.

Many diseases of environment are under our potential control already. Diseases like scurvy, beriberi, rickets, pellagra, are due to deficiencies of particular vitamins in the food. No doubt other abnormalities of body, including forms of mental weakness, will be found to be due to similar deficiencies, either in childhood or during embryonic life, and we know already, though not yet in enough detail, that deficiencies in diet diminish the resistance of the body to infective disease.

Lastly, we come to the great welter of disorders produced by the actual presence within the body of enemy parasites. These may be multicellular animals such as parasitic worms, unicellular forms such as the trypanosome of sleeping sickness, or the plasmodium of malaria; they may be bacteria, as in the infections of typhoid fever and pneumonia, or they may be minute bodies, barely visible by ordinary microscopes, which are the so-called 'viruses' causing diseases such as smallpox, measles, yellow fever, and so on. You have heard much of the great labours that have gone so far in giving us control over these enemies of our race, whether in tropical climates or at home. The work has involved clinical study of the diseases, intensive detective work to find out how the parasites are conveyed, whether by water, air, or soil, or by the intricate participation of insects and other carrying hosts. The study of these hosts and of the parasites themselves has been the work of zoologists in the field and in the laboratory, while the study of bacteria is a science by itself, with its specialised technical methods.

It is well known also that the knowledge gained here has already given us great powers in the prevention of disease, and an important part of the medical profession is devoted to their use in administration. I would only note here how random seems to be the relation of knowledge to power within this complex field. A very little knowledge of the infective agent concerned may give almost complete powers of prevention. We have the full power of preventing smallpox in any given man, or of distemper in any given dog, yet know much less about the nature of those viruses than about that of any other of the groups I have named. In malaria, on the other hand, we have a great deal of knowledge about the life history of the parasite and its mode of conveyance by the mosquito from man to man. We have the power of freeing any given community from the disease, but only if we have money enough to break the chain of events by getting rid of the mosquito carrier. We had this knowledge and this power a generation ago, yet there is more malaria in the world now than then, and it afflicts with its curse probably a third of the whole human race, with a death-rate of two million persons every year. What is needed now

is still more intensive research work that will allow us a more ingenious attack upon the parasite by methods which it may be practicable to use upon an immense scale at reasonable cost.

So much for preventive research. But protection from disease involves also its curative or palliative treatment; and here we come, for the first time, to the work of the medical profession as ordinarily understood, whether that of the physician or of the surgeon. When disease is beginning or has been established, the doctor is concerned to give his help in the most effective way to the single individual before him. This offers him an intricate set of problems which make his work a special branch of applied science in which high arts of skill are based upon the knowledge available. He cannot act effectively until he has found not only the nature of the disorder present but also its particular manifestations in that individual case. The very fact that he must avoid opening the body to look inside it has led to the development of intricate devices for observing and deducing the actual facts from the outside. I need not dwell upon the skill needed by the competent physician, nor upon the manipulative wonders now made possible to the surgeon by Lister's work: nor, again, need I do more than point to the high responsibilities undertaken by the physician or surgeon to whom a human life is entrusted. At every point their knowledge and skill depend upon the results of research work of many kinds, and their powers can only advance as research work progresses.

Lastly, there remains to consider, in the definition I am following, the protection of the body from accident, and its repair. The study of accidents has led to much profitable research work, of which some of the chief has been done under the Industrial Health Research Board. Accidents can be sorted out into those due to the unfitness of particular workers for given tasks, or to states of mind, or to conditions of fatigue and other states of the body, or, again, to the absence of proper protective devices and administrative rules. When their causation is accurately found, preventive work is at once rightly guided.

Under this last head, too, there is the skilled work of the surgeon in repairing physical damage done to the body. But we can only point to this here as completing our rapid survey of the whole campaign in the medical field. It is worthy of note that in coming to the end of this general story, we find ourselves close to the beginning of it again. Surgery has brought us near to the study of heredity again with which we started. For uncounted centuries the surgeon has repaired so far as possible the injuries of man's body in warfare and accident, and his chief concern has always been at least to prevent death by loss of blood. There is no more ancient surgical problem than that of whether a healthy man can lend some of his blood to save the life of another. Nearly three hundred years ago Dr. Lower of Oxford showed to King Charles II. and the early Royal Society that one dog's blood might be transfused into another dog to replace its own. But it has only been in the last twenty years that we have learned why it is that, while the blood of one man given to a patient who has suffered loss by bleeding may be fatal, that of another man may have no ill-effects and may restore life—and happily that knowledge came in time to save many thousands of lives in the War. Careful laboratory studies have shown that every human being belongs to one of four groups, distinguished by the different precipitating powers of their bloods, one against another. These subtle blood differences, far more subtle than any chemical analysis could detect, are of daily importance in surgery. They play a part also now in the study of human inheritance with which we began this survey.

(*To be continued.*)

Oriental Studies in the University of Chicago*

IN the past ten years the United States have made remarkable advances in archæological research in both the New World and the Old. In America itself the whole range of continental civilisation in one form or another from Alaska to Peru has been brought under investigation by university departments and public or semi-public institutions. In particular, the activities of the Carnegie Institution of Washington in Central America and of the Smithsonian Institution in the south-western United States have contributed materially to the advancement of archæological science through the intensive studies by means of which they are gradually filling in details of the chronological sequence in the development of culture in these areas.

In the Old World, both independently and in co-operation with European scientific bodies, American archæologists have extended their activities over a wide area. The American Schools in France, Athens, and Jerusalem and the expedition of the University of Pennyslvania, in conjunction with the British Museum, at Ur have achieved results of signal importance in the investigation of the history of man and his early civilisation. Less widely known, perhaps, but not of less moment, are the operations of the Oriental Institute of the University of Chicago, of which some account is given in a recent publication issued in commemoration of the opening of new buildings.

When the Oriental Institute was created by the trustees of the University of Chicago and organised by Dr. J. H. Breasted in 1919, its aim was to become "a research laboratory for the investigation of the early human career", and to trace "the course of human development from the merely physical man disclosed by the palæontologist to the rise and advance of civilised societies, the product of social and material evolution culminating in

* The Oriental Institute of the University of Chicago: in Commemoration of the Dedication of the Oriental Institute Building, Dec. 5, 1931. Pp. iv+68. 25 cents.

social idealism ". It was felt that the proper field for its operations could be only the Near East, the region around the eastern end of the Mediterranean. The formation of the Institute was made possible by the generosity, first of John D. Rockefeller, jr., and then of a number of other benefactors. Field expeditions were sent out and the work of the Institute rapidly outgrew the capacity of its first headquarters in Haskell Hall. In April 1930, ground was broken for a new building, which was completed in April 1931. In this the work of the Institute is now installed and completely equipped for its threefold activities of work in the field, study in the laboratory, and the publication and dissemination of results.

In the field, the Institute now maintains twelve expeditions, engaged in collecting original evidence relating to the origin and development of civilisation. Of these, six are concerned with ancient Egypt, two with Iraq, and four are distributed in Anatolia, Syria, Palestine, and Persia respectively.

In Egypt the work of the six expeditions, though not all are engaged in actual excavation, is so distributed as to cover the development of Egyptian civilisation from the very earliest times to the nineteenth dynasty, or even beyond. The Prehistoric Survey under Dr. Kenneth S. Sandford of Oxford has made a detailed investigation of the Nile valley, finding the earliest evidence of man yet discovered in the Near East at the bottom of the gravels of the former Nile valley, and determining the date of the desiccation of North Africa and the formation of the Sahara. At Sakkara, the expedition under Prof. Prentice Duell has launched a programme for the complete record in five folio volumes of the great treasury of relief paintings in the masonry tombs of the cemetery of ancient Memphis. After nine years' work, Dr. Alan Gardiner and Dr. A. de Buck have completed the copying of the Coffin Texts from Middle Kingdom burials, which are essential for the study of the Book of the Dead. These are now being edited and will be published in a series of five volumes. In association with the Egypt Exploration Society, the Institute is saving the records of the beautiful temple of Seti I. at Abydos, "the loveliest works of art of the ancient world". These will also be published, mostly in colour, under the editorship of Prof. Gardiner, while the work is being carried on by Miss Amice M. Calverley, assisted by Miss Broome. Mrs. N. de G. Davies is also engaged in copying, in colour, paintings in the tombs of the great Theban cemetery. These paintings, together with series previously painted by Mrs. Davies for Dr. Gardiner, are to be published, the first volume appearing in 1932.

At ancient Thebes the Institute has its largest undertaking in the Near East, in the Epigraphic and Architectural Survey Expedition. The work of this expedition was begun in 1924–25, and with it is now combined the headquarter work of the Institute, for which a new building, in California-Spanish style, has recently been erected at Luxor. For seven years this expedition has been at work on the colossal temple of Medinet Habu and associated structures under Prof. Uvo Holscher. These excavations have revealed the surprising fact that the largest halls of the palace of Rameses III. had vaulted ceilings and were not flat-roofed as were the temples.

In Western Asia, as in Egypt, the work of the Institute has been planned on lines which are at once comprehensive and at the same time admit of expansion without danger of overlap and waste of effort. Two expeditions are working in the "Highland Zone" under the general direction of Dr. H. Frankfort. Four mounds are included in the concession which the Institute holds from the Government of Iraq. Of these mounds, Tell Asmar (Ashnunnak) is the most important. Here extensive headquarters have been erected. A large palace of Sumerian age has been discovered, of which the excavation is to be completed in the current year; while on another mound at Khafaji, about ten miles away, a large fortified enclosure with temples and dwellings has been uncovered. South of the "Highland Zone", where the cities and palaces of the Assyrians are important sources for evidence of a composite culture which draws its material from both north and south, the Institute is excavating the palace of Sargon II. at Khorsabad. Here Dr. Edward Chiera is following excavations begun by the French more than eighty years ago. Many valuable relief-sculptures have been discovered, including a huge winged bull, partly in the round, which, on the allocation of the Iraq Government, has been brought to Chicago.

In Anatolia, excavations on the Hittite city mound of Alishar in 1930 and 1931 have added this as the third of the sites on which clay tablets of Hittite cuneiform have been found. This expedition has done pioneer work in plotting the archæological levels, with the result that the careful listing and sequence identification of types makes available for the first time a history of the pottery in Hittite territory. A discovery of which the precise significance is as yet difficult to forecast is the apparent survival to-day of ancient Hittite speech in a small isolated village of Anatolia. It has been recorded by Dr. J. Mészáros, of the Angora Museum, and is to be published by the Institute.

In Syria, exploration has identified an ancient mound as the city of Calneh, to which reference is made by the prophets Amos and Isaiah as one of the Assyrians' greatest enemies in the west. A concession for the excavation of this site and a neighbouring mound has just been granted by the French authorities under their mandate. Headquarters are being erected and work will be begun on the two mounds simultaneously. The Palestinian expedition is occupied in the investigation of the city of Megiddo, one of the most important of strategic points in the history of the country. The Institute has recently acquired control of the whole site, an area of more than thirteen acres, and is now stripping off systematically stratum after stratum of the deposits. Up to the present, the expedition has descended to the stratum of the Hebrew kings. The finds included the stables in which Solomon kept the blooded horses imported from Egypt for

sale to the Hittites. An interesting innovation in the work on this site is the employment in air photography of a small captive balloon which carries a camera operated from the ground. Its use is fully described for the first time by Mr. P. L. Guy in *Antiquity*, June 1932.

A concession from the Persian Cabinet to explore and restore the palace of Persepolis has been inoperative until recently owing to lack of funds; but a generous anonymous donation has now made it possible to begin work. Dr. E. Herzfeld, of the University of Berlin, has been placed in charge of the excavation. As a preliminary, and in order to provide accommodation for the expedition, six chambers in the palace have been cleared. These chambers have afforded some interesting material, which *inter alia* indicates that they had once been part of the quarters of the harem of Darius.

Of the activities of the Institute in research and publication in Chicago, no more can be said here than that they keep fully abreast of the strenuous work of the expeditions in the field in dealing with the original material, and at the same time foster inquiry on other and cognate lines. Throughout its activities the characteristic feature of the work of the Institute is the breadth of vision with which its operations have been planned, combined with a singleness of direction towards the aim which was marked out for the Institute at its inception. It is scarcely necessary to indicate to what an extent in this, as in other matters, the Institute is indebted to its director, Dr. J. H. Breasted.

Obituary

M. Santos-Dumont

THE death at São Paulo, Brazil, on July 23, of M. Alberto Santos-Dumont, at the age of fifty-nine years, removes another of the few remaining pioneers through whose efforts mechanical flight was achieved. Santos-Dumont was the first in Europe to make a public flight in a heavier-than-air machine, while his numerous experiments with dirigible balloons stimulated the progress of airship construction. His enthusiasm and intrepidity led him into many adventures, and his flights with small airships in the neighbourhood of Paris some thirty years ago made his name famous throughout the world.

Santos-Dumont was born on a large coffee estate at São Paulo on July 20, 1873, and it was during a visit of his family to France in 1892 that he began his work on dirigible balloons. By 1898 he was in possession of his first airship, and during the next few years he constructed about a dozen of various sizes, driven by internal combustion engines. With one of these, on Oct. 19, 1901, he made a flight from St. Cloud around the Eiffel Tower and back, in 29½ minutes, and thus secured the prize of 125,000 francs offered by M. Deutsch de la Meurthe. To commemorate the event, the Brazilian Government struck a special medal. The airship in which the feat was accomplished was of 22,000 cub. ft. capacity, and was driven by a 12 h.p. engine. During his experiments Santos-Dumont had many narrow escapes, and on one occasion had to be rescued from the roof of the Trocadero by firemen. His airships were all of the non-rigid type.

From the airship Santos-Dumont next turned to the aeroplane, then engaging the attention of the Voisins, Ferber, Archdeacon, Blériot, and others in France. Though familiar with the gliding experiments of Octave Chanute, little was yet known by workers in Europe of the aeroplane of the Wright brothers and of their historic flights in December 1903 at Kitty Hawk, South Carolina. By the beginning of 1906, however, Santos-Dumont had constructed a biplane with wings of box-kite form, and with this machine, on Aug. 22 that year, made the first public flight on record in the Old World. The same year he made other short flights. The machine was called *The Bird of Prey*. "Its main double-decker planes", wrote Miss Gertrude Bacon, "were tilted up at a considerable angle. There was no tail, but in front a big box-kite elevator; so that the thing appeared to fly tail foremost, or as someone said, like a duck with its neck outstretched. On a light, open framework in the midst, mounted on bicycle wheels, was the 50 horse-power Antoinette motor, driving the propeller at the back, and the sort of wicker waste-paper basket in which the aviator stood."

According to the *Times*, M. Santos-Dumont will be buried in the family vault at São Paulo, over which a monument will be erected identical with that set up some years ago at St. Cloud to mark his historic flight of 1901.

Prof. A. Humboldt Sexton

Prof. A. Humboldt Sexton died on June 21, at Jersey, at the age of seventy-eight years, after a long illness. He was the eldest son of Dr. George Sexton, who was well known in his time as a lecturer on spiritualism and later as a Christian apologist, and he was educated at private schools and the Royal School of Mines. He obtained a Royal Exhibition tenable at the Royal College of Science, Ireland, in 1871. In 1873 he became assayer to the Mining Company of Ireland, and in the following year was appointed chemist to the Broughton Copper Works.

Appointed science master to the Wedgwood Institute, Burslem, in 1881, in the following year Sexton became lecturer in chemistry and metallurgy at the Manchester Technical School. Two years later he was appointed professor of metallurgy at the Glasgow and West of Scotland Technical College, a position which he held until his retirement in 1909 with the title of emeritus professor.

Prof. Sexton was a past-president of the West of Scotland Iron and Steel Institute, and his numerous books on chemistry, metallurgy, and refractories were well known and much used in schools and colleges. He also published many papers in technical and scientific publications.

Upon his retirement, Prof. Sexton became Minister of the New Church at Jersey, and afterwards held a similar appointment at Liverpool and Northampton. He gave up the latter post in 1923 and returned to Jersey.

PROF. W. W. KEEN

PROF. WILLIAM WILLIAMS KEEN, who died on June 7 at the age of ninety-five years, gained his reputation as a surgeon during the American Civil War, and for a period of more than fifty years thereafter was recognised as the most outstanding figure in American surgery. He was a contemporary of Oliver Wendell Holmes, and like him had uncommon gifts of personality and scholarship. His textbook on surgery enjoyed a world-wide reputation for many years, and made his name known far beyond the University of Pennsylvania, in which he taught, and the city of Philadelphia, in which he practised.

Dr. Keen was one of the first to adopt and apply to surgery the principles and practice of Listerism. He was a scientific surgeon in so far as it is yet possible for a surgeon to be guided by scientific principles, and although the author of innumerable contributions to surgical literature, all of which added something to the subject dealt with, yet it was his personality and general proficiency rather than his originality in any particular field which gave him the high place he enjoyed for so many years.

Dr. Keen recognised that surgery depended for its advance on the growth of the basal subjects of medical education, particularly of experimental physiology, and never wearied in his defence of vivisection and of temperance. Like the late Sir William Osler, he was a bond between the medical professions of the United States and of Great Britain.

WE regret to announce that Miss Adelaide Ames, research assistant in the Harvard Observatory, was drowned in a canoe accident in Squam Lake, New Hampshire, June 26, at the age of thirty-one years. Her scientific work, thus suddenly ended, had already gained for her a wide recognition. She was a member of the Commission on Clusters and Nebulæ of the International Astronomical Union. For several years Miss Ames had carried on investigations in the field of extra-galactic nebulæ, her principal publications dealing with the Coma-Virgo cloud of galaxies. Her most important work was in connexion with a photometric survey of all extra-galactic objects to the thirteenth magnitude —a census of the inner parts of the metagalaxy to a distance of five to ten million light-years. This survey was completed in June and will be published during the next month in collaboration with Dr. H. Shapley.

WE regret to announce the following deaths:

Dr. Geo. K. Burgess, director of the U.S. National Bureau of Standards, and treasurer since 1924 of the National Academy of Sciences, on July 2, aged fifty-eight years.

Prof. Matthew Hay, emeritus professor of forensic medicine in the University of Aberdeen, formerly medical officer of health for the city, on July 30, aged seventy-six years.

Prof. John R. F. Sebelien, formerly professor of chemistry in the Agricultural College, Aas, Norway, known for his contributions to the chemistry of milk and dairy feeding and artificial manures, aged seventy-four years.

Sir William Willcocks, K.C.M.G., the distinguished irrigation engineer whose name is associated with the Assuan dam and the Assiut barrage in Egypt and with irrigation work in Mesopotamia, on July 28, aged eighty years.

News and Views

Dr. P. A. M. Dirac

DR. P. A. M. DIRAC, of St. John's College, Cambridge, has been appointed to succeed Sir Joseph Larmor when he vacates the Lucasian chair of mathematics at Cambridge on Sept. 30 next. Dr. Dirac has been one of the most notable of the group of young physicists (mostly within a year or two the same age) who have, during the past seven years, created quantum mechanics. After graduating at the University of Bristol both in engineering and in mathematics, he entered the University of Cambridge as a research student in the Faculty of Mathematics, and may perhaps not unreasonably be accounted fortunate in his time, for he was in the middle of his course for a research degree when the ferment of dissatisfaction with the limitations of the older quantum theory was at its height, and the great blaze of theoretical advance was set alight by Heisenberg's first paper of the autumn of 1925. Dr. Dirac was one of the first to see clearly how the new ideas were to be extended and formalised, and his own researches have played a great part in both these processes, especially in formalisation. His unpublished degree thesis was probably the first such attempt to present in any detail in a consistent and logical way the revolutionary new theory. Later he published a much expanded and revised form of this attempt in his well-known book on quantum mechanics. His most strikingly original and successful contribution to the whole theory is his relativistic theory of the electron, a contribution in which his great mastery of and instinct for form has guided him at once to the correct generalisation. Dr. Dirac will succeed to the Lucasian chair when he is just over thirty years of age, with the acclaimed consent and good wishes of all his colleagues in mathematical physics in Great Britain. His University may look forward to another long and distinguished tenure of a chair to which long and distinguished tenures are by no means unfamiliar.

New Skull from South Africa

PROF. DUBOIS' comment on the skull recently discovered at Ngandong, Java, and its relationship to Rhodesian man, which appeared in NATURE for July 2,

p. 20, enhances the interest with which anthropologists will await further particulars of the human skull which, it is announced, Prof. T. F. Dreyer, of Grey University College, Bloemfontein, has discovered at Florsbad hot springs. According to a message in the *Times* for July 27, Prof. Dreyer has found parts of a human skull and a tooth, associated with stone implements of a primitive type and the remains of extinct fauna on this site, which lies twenty-five miles north of Bloemfontein. The lower jaw is missing, but, it is said, most of the facial bones are present. The character of the skull cannot be determined with certainty until the base has been found; but Prof. Dreyer is reported to be of the opinion that it is that of either Neanderthal man or Rhodesian man. According to the measurement of the skull "over the eyes", it would hold a place intermediate between the two, the figure given being 130 mm., as against the maximum in Neanderthal man of 125 mm. and 139 mm. in Rhodesian man. These figures, slender evidence as they are, are certainly suggestive of the possible significance of the new find in relation to the affinities of early types of man in South Africa. Should it appear eventually that the skull is a second specimen of Rhodesian man, its association with stone implements and extinct fauna should provide the much desired evidence indicating the geological age and the culture of that remarkable type of primitive man.

Exhibition of British Archæology

AN exhibition illustrative of recent field-work in British archæology was arranged at the London Museum in connexion with the International Congress of Prehistoric and Protohistoric Sciences which met in London on Aug. 1-6. Its primary object was to afford visitors from abroad some idea of the range and value of the material which archæological investigation in Great Britain is adding to the study of prehistoric and early historic times; but it was also intended to interest and inform other visitors to the Museum whose acquaintance with archæological studies might not be sufficiently intimate to keep them abreast with the activities of our research workers in the various provinces of the subject. The exhibits ranged from the pre-palæolithic discoveries of Mr. Reid Moir in East Anglia to the objects of late Saxon and Viking times from districts so far removed from one another as Durham and Dorset. The choice of sites illustrated was discriminating and the number of objects shown kept as low as possible, consistently with the aim of making the exhibition representative. It is, therefore, difficult to single out any one or two exhibits as especially worthy of note. Colchester and Verulamium naturally figured prominently, as also did Mr. A. Keiller's exhibit from the Windmill Hill site. No doubt many visitors were glad to avail themselves of Mr. Keiller's offer of admission to view the complete collection of finds shown at Charles Street, Berkeley Square. The interest of the exhibition was much enhanced by the magnificent series of photographs from the air of various classes of site which was lent by the Ordnance Survey and described in an admirable catalogue. An excellent descriptive catalogue was also prepared for the archæological exhibits. Probably it will be a long time before so completely representative a collection, drawn from widely distributed places of permanent exhibition, will be gathered together again.

Methods in Anthropometry

FOR a considerable period it has been apparent that the time was ripe for a measure of revision of the methods of anthropometry, although caution was enjoined by a not unnatural reluctance to take any steps which might lessen the value, for comparative purposes, of thousands of measurements taken by generations of anthropologists in the field and laboratory. The feeling of dissatisfaction with existing methods, however, both among British and Continental anthropologists, was sufficiently strong to warrant discussion; but it cannot be said that anything practical had emerged until recently, when certain suggestions were put forward jointly by Miss M. L. Tildesley, Dr. E. G. Morant, and Dr. L. H. Dudley Buxton as a report to the council of the Royal Anthropological Institute. Briefly, these suggestions are that for the moment there should be an agreed abbreviated technique of observations in anthropometry, confined to the racial characters of adults of both sexes; and that this should be determined and elaborated as required by an international committee. But it is put forward as a first step that a technique should be formulated for Great Britain and Ireland; and at the same time representative bodies in other countries should be invited to do the same for their areas, with the view of international discussion later. The proposal, with further suggestions as to detail, will be found in *Man* for July. While this courageous attempt to deal with a difficult situation scarcely calls for comment at the present stage, it may be pointed out that without an assurance of external support the proposal risks a great deal of wasted effort. British anthropologists cannot work in isolation, however considerable the proportion of their output in the world of anthropometric science may be.

Changes in Scientific Outlook

SIR OLIVER LODGE on March 17 gave the oration at the thirty-sixth Foundation Week at University College, London. It was well received at its delivery, and is well worth reading in its published form (University of London Press, 1*s*. net). Sir Oliver is now so generally accepted as the best exponent of a tolerant, humane, and comprehensive way of regarding science that when he speaks, as he did, on "Changes in Scientific Outlook", he might expect an attentive audience. The address was eloquent, impressive, and highly stimulating to thought, but it scarcely covered the matter which the title would lead one to expect. There is little or nothing in it of the latest developments in science, the extension of specialisation, the connexions of astrophysics with laboratory work, the exploration of the border-line problems between animate and inanimate. Sir Oliver practically confined himself to the one issue which in his view outweighs in ultimate importance all the others, and the address might well be called "A Plea

for the Spiritual in the Realm of Science". The spiritual in this case is not to be identified with the 'spiritual' which Sir Oliver has so closely and patiently pursued in the purely human sphere. He has, as always, a word on this topic, and pleads for the open mind, a plea which every fair-minded person will be willing to support. But he goes on to speak—and it is the burden of his speech—of the need of admitting a spiritual explanation of the phenomena of the world as a whole.

Spiritual Elements in Science

SIR OLIVER is arguing throughout with those who maintain the strictly scientific or agnostic attitude, and in doing so he postulates what he calls "spiritual elements" or a "spiritual influence", which at the end of his discourse he weaves into "the one Reality which gives meaning to the existence of the whole material world . . . and illuminates the whole universe with Immortal Love". It is a fine passage, which takes us back to the triumphant finale of Dante's "Paradiso"—but one is bound to recognise that it is a supreme act of faith, an apotheosis of the Unknown rather than any extension of the scientific outlook. Science, *qua* science, will agree with Sir Oliver that the mere fact of the human mind attaining the power of prediction—forming, that is, scientific laws—proves that the universe, as presented to us, acts in an orderly or rational way. It will also agree with him that the progress of the human mind exhibits the development of truth, beauty, and love. But when he proceeds to evoke and apply these conceptions—as he frankly does—at any point in the story of evolution where scientific knowledge fails, one sees a danger and remembers the famous Hippocratic diagnosis of the sacred disease; the 'sacred disease' was that of which men had not yet discovered the natural cause. Our religion should inspire and encourage, but, above all, it must not relieve us of the primary duty of following the truth into its most remote retreat.

World Agricultural Policy

THE general assembly of the International Commission of Agriculture, which met at Lausanne on July 21–22, was attended by delegates from sixteen countries and thirty-five national agricultural organisations, and a statement has been issued on world agricultural policy. It was emphasised that the world agricultural crisis is due to the fact that production and the increased means of securing production have outstripped both present consumption possibilities and population increases, while purchasing power has meanwhile declined. The Commission therefore considers that a judicious organisation of production and exchange will constitute one of the most effective means for fighting the agricultural crisis and establishing the prosperity of nations on a new basis. The first step would be to substitute orderly marketing, through the agency of associated bodies or by means of systematic State-controlled quota import arrangements, for the present unregulated offers of large quantities of commodities on world markets. Simultaneously, all means of stimulating consumption in general will have to be considered. Efforts will have to be made to improve and regularise quality and to cheapen retail sale. An appropriate wages policy will have to be adopted which, while allowing of a decrease in the number of the unemployed, will take account of national purchasing power. The question of new markets should also be studied, and, for the time being, also that of the export of existing surpluses to countries where the populations are suffering from underfeeding or famine. Further, an increased consumption of products of animal origin would absorb a larger portion of the surplus of vegetable products, which would be transformed into milk and meat. Finally, building should be encouraged by all suitable means. The International Commission of Agriculture recommends agriculturists to support the work of international collaboration, to associate themselves with efforts which aim at the maintenance of peace, at guaranteeing the security of property, and at drawing closer the bond which unites economic groups and nations in a common interest.

International Scientific Centres in Paris

LA Maison du Savant, which is to be built in Paris, will be a well-appointed meeting-place for French and foreign men of science, if the present plans come to fruition. Lecture rooms, restaurant, winter-garden, and other amenities will be at the disposal of members and visitors. In addition, it will possess an extensive office of information which will study projects for the erection of up-to-date laboratories and research institutions, and organise congresses, exhibitions, conferences, and all publicity necessary to attain the organisation's aims. An illustrated periodical will also be published eventually, to inform the public of the general progress of science. Other activities include a benevolent fund and the provision of scholarships. The Maison du Savant is under the patronage of M. Lebrun, President of the French Republic; it has received government support, and its honorary committee consists of a distinguished group of academicians, including MM. le Chatelier, Charcot, le duc de Broglie, Richet, etc. Its founder and president is M. Georges Lecuyer, president of the International Union of Decorative Arts, and its active director is M. Jean de Chappedelaine. The organisation hopes to raise fifty million francs in the near future for its extensive programme. Through the official support of the Chamber of Deputies and the Municipality of Paris, a beginning has been made with convenient office rooms at 5 Avenue de l'Opéra, Paris.

"LA Maison Internationale de la Science" is a project put forward on the occasion of the Colonial Exhibition of last year, during an international congress of men of science and research workers, for the furtherance of their interests. Its temporary headquarters are at the Institut Marey, Avenue Gordon-Bennett, Paris. It has not been very active, owing to the absence of its director, M. Pélissier, on a government mission to the island of Réunion; in all probability it will join forces with the Maison du Savant. "Le Foyer International Universitaire" is a centre

planned by the University of Paris. It was to be housed in part of the hôtel de la Rochefoucauld d'Estissac; this, however, has been bought by the "Maison de la Chimie" (see NATURE, June 11, p. 865) for three million francs, which will be used by the "Foyer International Universitaire" to acquire another building in rue de la Four (the former École de Bouffémont). "Le Cercle Universitaire International" is a club projected by the Associations of University Students to receive visiting colleagues and university men and to organise meetings and lectures that will promote international friendship. Its president is M. Paul Langevin, and its temporary address is at the Musée Pédagogique, 41 rue Gay-Lussac, Paris.

Institut International de Documentation

THE eleventh Conference of the Institut International de Documentation (formerly de Bibliographie) will be held this year at Frankfort-on-Main on Aug. 30-Sept. 3. The Conference is open to all persons interested in the various aspects of documentation, that is, the collection, arrangement, filing, and indexing of graphic records. As in previous years, an attractive programme of papers has been arranged for presentation and discussion during the mornings, whilst the afternoons and evenings will be devoted to visits of inspection and recreation. The latter include visits to Darmstadt and Mainz, where State and municipal libraries will be inspected. The Conference fee of 12 R.M. includes all excursions. A special exhibition of technical appliances for library purposes (Adrema machines, photocopying apparatus, duplicating machines, metal furniture, etc.) has been organised in a room of the Conference building during the meeting. The programme of papers to be presented is not yet available, but copies of all papers will be distributed to members of the Conference prior to the opening session. Full particulars regarding hotels and accommodation and further details of the Conference may be obtained from the organising secretary, Dr. Schürmeyer, Direktor der Bibliothek für Kunst und Technik, Frankfurt am Main, or from the Secretary, British Society for International Bibliography, Science Library, South Kensington, S.W.7.

Sotheran's "Bibliotheca Chemico-Mathematica"

MESSRS. Sotheran, Ltd., have issued a first supplement to their "Bibliotheca Chemico-Mathematica" which was published in two volumes in 1921, and have again laid all students of science and technology under a debt of gratitude. The work pretends to be no more than a bookseller's catalogue, and does not, therefore, aim at completeness, but in fact it contains a most representative list of works, to the number of more than seven thousand items, of old writers in all branches of science, and a number of standard modern works. It is rendered of permanent reference value by the fact that the title-pages in the majority of cases are transcribed in full, and by the unusual wealth and scope of the notes that accompany most of the entries. One of the most interesting items (presumably to be sold as a whole) is a collection of more than eight hundred books from Newton's library, including copies of the first and second editions of the "Principia" with corrections, cancellations, and additions in Newton's handwriting—many of which were not incorporated in the later editions and would thus be of the utmost interest as showing the progress of Newton's thought—an annotated copy of Euclid, and many other works with Newton's autograph.

THE catalogue also includes a few books that belonged to Faraday and were bound and annotated by him, original copies of the first edition of Galileo's "Dialogo", a complete set of the Paris Academy's "Description des arts et métiers", with all its supplements, which is very rarely seen in the sale room—or the library—in its complete form, and, especially noteworthy, a copy of William Gilbert's "De Magnete", 1600, inscribed in what appears undoubtedly to be the autograph of the author, of which no other universally accepted example is known. The annotations are trustworthy and of great interest, and will save a great deal of searching through scattered authorities, the latest of whom appear to have been consulted. It is good to see that the title 'Honourable' is no longer given to Henry Cavendish, and it is to be hoped that Messrs. Sotheran's correction will finally destroy this persistent delusion. Prices appear to have risen since the date of the original catalogues, but remain moderate. Booksellers' catalogues are usually looked through rapidly for desired acquisitions, and if kept at all, are cut up for filing purposes, but the present volume is a bibliographical tool of value and should take its place beside its predecessors on the library shelf. It and the volumes still to come form a worthy memorial to the late H. C. Sotheran, to whom the volume is dedicated.

A New Periodical on Acoustics

THE rapid development of acoustics since the production of the thermionic valve is accompanied by so large an increase in the bulk of research papers that for some time the Acoustical Society of America has been publishing its own *Journal* devoted to the subject. A French journal, *Revue d'Acoustique*, is now to be published bi-monthly under the direction of a committee of well-known authorities. The first number, dated March 1932, wisely opens with a vocabulary, founded on that of the Committee on Acoustical Standardisation (*J. Acoustical Soc. of Am.*, **2**, No. 3), of acoustical terms with definitions and English equivalents, and authors are asked to indicate when they use a term with a different meaning. In addition to papers, abstracts longer than those usually available in *Science Abstracts* and a bibliography of papers and books published since 1925 are given. This latter section is classified under physiological acoustics, acoustic measurements, propagation, sound sources, sound receivers, music, mechanical music, noise and architectural acoustics, and books and general articles. The titles are given in French, with some inconsistencies of translation. Although a journal of acoustics will naturally be used

most by those interested in applied acoustics, several important general works published since 1925 might with advantage be included in the bibliography. The six books given are scarcely representative, sources in English being represented solely by the Physical Society's discussion on audition. A list of more than two hundred periodicals which are to be searched for the bibliography is given as a supplement. The address of publication is Les Presses Universitaires de France, 47 Boulevard Saint-Michel, Paris 5e.

Vocational Tests for School Children

THE City of Birmingham Education Committee has published the results of an investigation by E. Patricia Allen and Percival Smith into the value of vocational tests as aids to choice of employment (Treasurer's Department, Council House, Birmingham. 1*s*. net). Every child leaving school in Birmingham is carefully advised as to his future occupation, but it was felt that vocational tests might give the employment conferences more adequate data on which to base their suggestions. For the purpose of this experiment, the children leaving three schools were divided into two groups : one group was treated in the usual way, while the other was examined by special tests for manual, mechanical, and clerical ability, dress-making, and intelligence, and studies were added of social, medical, and temperamental conditions. The advice given was then based on the results. When the children had obtained work, there would be four categories, namely, the tested children who did and did not follow the advice, and the controls who did and did not. Evidence as to the progress of these groups in their industrial careers was then compiled over a period of two years. Although the report makes no extravagant claims, yet the general tendency was for the tested children, who were placed in accordance with the advice given, to be more satisfactorily placed than those in the other three categories. The writers report that a surprisingly large number of the parents had no ideas for their children, nor did the children as a rule know what they would like to do. The report is excellent, sufficient details being given, with the exception of the testing for temperament, to enable other workers to follow this up and use it for comparison. The results are in agreement with the previous London research.

Tung Oil in the United States

THE establishment of the tung oil industry in the United States has been so successful during the last few years that a move is now being made to expand it on such a scale that America will cease to be dependent on China for even small quantities of this commodity. Dr. H. A. Gardner has recently described the position in a paper before the American Chemical Society (Science Service, Washington). Tung oil is essentially an oriental product, used through the ages by the Chinese for making native lacquer and ink. It is manufactured from the seeds of a deciduous tree, *Aleurites*, native to China, on much the same principle as peanut oil is produced by milling from peanuts in that country. Seeds were first introduced into America through the agency of the U.S. Department of Agriculture in 1905, and planted at the Government Experimental Station then at Chico, California. Extensive plantings, however, were not made until some eight years ago in the southern States, which were so successful that already 25,000 acres of land have been given over to the industry. The American Paint and Varnish Association is particularly concerned with this venture, as the oil is a valuable ingredient of varnishes and varnish paints. Apart from these uses, the American industries have extended considerably the application of tung oil, and it is now employed in the manufacture of insulating compounds, brake linings, linoleum, waterproofing fabrics, as a binder for wall board and plastic synthetic lumber, primers, synthetic resins, battery jar compounds, aeroplane tubing fillers, and so on.

American Institute of Physics

FOR several years, a movement has been on foot in the United States to bring about co-operation between the several American societies devoted to physics and its more immediate branches. This has recently had its culmination in the formation of the American Institute of Physics, comprising the American Physical Society, the Optical Society of America, the Acoustical Society of America, the Society of Rheology, and the American Association of Physics Teachers. The purposes of the Institute are subject, of course, to natural development in accordance with the future needs of its founder societies. For the present, its principal activity is the publication of journals. The societies are delegating to the Institute the responsibility for publishing the journals which they have in the past sponsored themselves. The reason for this course of action is the promotion of economy and efficiency. The list of the journals includes the *Physical Review*, *Physics*, *Reviews of Modern Physics*, *Journal of the Optical Society of America*, the *Review of Scientific Instruments*, *Journal of the Acoustical Society of America*, and *Journal of Rheology*. The scientific editing of the journals remains the duty of the societies, while all the details in the handling of proofs, subscription records, book-keeping, and the like are undertaken by the Institute. Two important other functions have been assigned to the Institute, namely, the further co-operation with societies and agencies outside the founding group, and the extension of an information service to the Press. The central office of the American Institute of Physics is at 11 East 38th Street, New York City.

Manufacture of Insulators

THE *Vista* is a periodical published by the British Porcelain Co., Ltd., London, S.W.1, and deals mainly with subjects of interest to the electric power industry. In the May number it concludes a series of articles on insulator manufacture. Each piece of electrical porcelain is carefully inspected by factory inspectors immediately after removal from the kiln, and all pieces failing to pass this inspection are destroyed. To find the porosity, fragments of the porcelain are

placed in fuchsine dye and subjected to a pressure of two thousand pounds per square inch for twenty-four hours. They are then removed, carefully dried, and broken to find out whether there is 'penetration' or not. If any is noticed, the representative batch of insulators is destroyed. The thermal test consists in immersing the porcelain in boiling water and then in iced water for periods of ten minutes, one hot and one cold test constituting a thermal cycle. After five such cycles, the porcelain is flashed over to test for thermal failure. After further thermal cycles, the insulators are subjected to a flashover test. They are next subjected to a flashover test at a frequency of 250,000 cycles per second. This test has proved a boon to the industry, as it eliminates porcelain with dielectric defects. In assembling the insulators, Portland cement with a definite proportion of pure water is used. They are allowed to stand five days before being cleaned and treated with weather-proofing compound, and after three more days a routine tension test is applied. The final tests are made in the presence of the customers' inspector, who sees the large completed insulator subjected to a load of 10,000 lb. weight and to a high-frequency flashover.

The Census of India

IN a paper read to the Royal Society of Arts on June 3, Dr. J. H. Hutton discussed some of the figures of the Indian census of 1931. Perfect accuracy in enumeration is not to be expected, and in this census there were certain unusual difficulties. From estimates based on those regions where the census was known to be incomplete for reasons that can be traced, it may be assumed that the deficiency for the whole of India is not more than one per mille. It was calculated that the normal increase in the decade 1921–31 should have been 8 per cent, or rather less if allowance were made for the last influenza epidemic and its inroads on population of the reproducing age. The actual increase, however, proved to be 10·6 per cent, a rate exceeding any previous record. The increase was greatest in the Native States and apparently has been most marked in the less fertile parts of the country, which is an indication of the pressure on agricultural land. In some cases, heavy increases have been due to an extension of irrigation. The lowest density came from certain districts of Baluchistan and the highest from part of Cochin, where the density exceeds even that of Java. There has been little change in the general proportion of urban to rural population. In 1931 the total percentage of urban population was 11·0 per cent as compared with 10·2 per cent in 1921. The proportion of females to males is falling and is now 940 females to every 1000 males.

Announcements

THE Medical Research Council has appointed Mr. Ernest Bevin, Dr. C. G. Douglas, and Mr. W. S. Morrison, M.P., to be members of the Industrial Health Research Board in succession to Mr. Arthur Pugh, Prof. E. P. Cathcart, and Major A. G. Church, who retire by rota on Sept. 30.

AT the quarterly *comitia* of the Royal College of Physicians of London held on July 28, the Bisset Hawkins Gold Medal was awarded to Dr. T. H. C. Stevenson for his work as superintendent of statistics in the office of the Registrar-General. It was also announced that the Harveian Oration will be delivered by Sir George Newman, Chief Medical Officer of the Ministry of Health and Board of Education, on Oct. 18.

AT a meeting of the Council of the North-East Coast Institution of Engineers and Shipbuilders, held on July 22, the following medals were awarded: the Engineering Gold Medal to Messrs. L. J. Le Mesurier and R. Stansfield, for a paper entitled "Combustion in Heavy Oil Engines"; the Shipbuilding Gold Medal to Dr. F. H. Todd, for a paper entitled "Some Measurements of Ship Vibration"; the Thomas Fenwick Reed Medal, "for ability to take a share in the control of industry", to Mr. W. Spencer Paulin. The first Andrew Laing Memorial Lecture of the Institution will be delivered on Oct. 28, by Eng. Vice-Admiral Sir R. W. Skelton, Engineer-in-Chief of the Fleet.

IT was announced at the annual meeting of the Wiltshire Archæological Society, which was held at Malmesbury on July 26, that the outgoing president, Mrs. M. E. Cunnington, in conjunction with her husband, Capt. B. H. Cunnington, had offered the nation the now famous prehistoric sites of Woodhenge, near Stonehenge, and the Sanctuary, near Avebury. These sites were purchased and excavated by Capt. and Mrs. Cunnington after their discovery from the air. They have since been fenced and the ring of post holes, in which the wooden, and in the latter wooden and stone posts, formerly stood, marked by low concrete pillars, showing the plan of the monuments. This generous offer has been accepted by the Office of Works.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in civil engineering at the University College of South Wales and Monmouthshire, Cardiff—The Registrar (Aug. 8). An assistant for abstracting scientific and technical papers at the Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1.—The Secretary (Aug. 8). An assistant engineer in the Harbour Engineer's Department, Colombo Port Commission, Ceylon—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (Aug. 8). A curator at the Art Gallery and Museum, Doncaster—The Town Clerk, Town Clerk's Office, Doncaster (Aug. 9). Junior scientific officers in the Scientific Research Pool, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Aug. 18). An engineering assistant for the Portsmouth Water Company—The Engineer, Water Company's Office, 26 Commercial Road, Portsmouth (Aug. 22). A principal at the Kadoorie Jewish Agricultural School, Mount Tabor, Palestine—The Chief Secretary to the Government of Palestine, Jerusalem (Aug. 30).

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.*]

Superconductivity with High-Frequency Currents

FURTHER experiments have been carried out by us in this laboratory on the phenomena of superconductivity with alternating currents of high frequency, following those already reported.[1] In these experiments, observations have been made on the resistance of a conductor at low temperatures when both alternating (frequency 12×10^6) and direct currents were flowing simultaneously. The curves show the variation of the resistance with the temperature; the temperature was controlled and estimated by the vapour pressure of liquid helium.

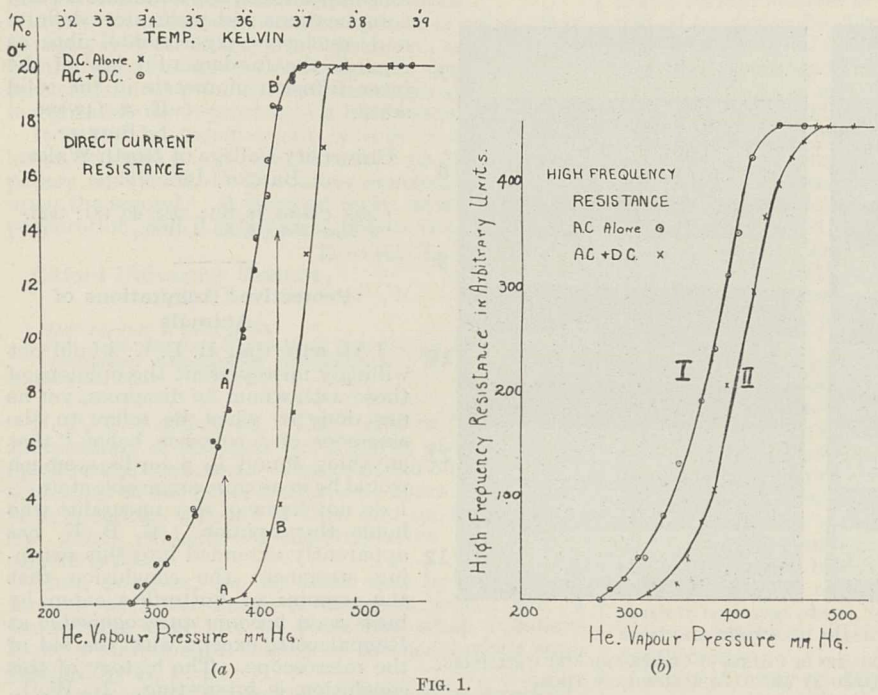

FIG. 1.

The experiments may be divided into two sets:

(*a*) The resistance offered to direct currents by the metal (tin) was measured both with and without accompanying high frequency currents.

(*b*) The resistance offered by the same sample to high frequency currents was measured both with and without accompanying direct currents.

The resistances of the conductor to direct currents and to high frequency currents were measured by independent methods, as indicated in the paper referred to above.

The results may be stated thus:

(1) (Fig. 1 (*a*)). Curve AB represents the relation of R/R_0 and temperature (Kelvin) for direct current. When, in addition to the direct current, high frequency currents were induced in the same conductor, the resistance to the d.c. changed so as to shift the curve towards lower temperatures ($A'B'$). The switching on and off of the high frequency generator changed the resistance reversibly from the point A to A', from B to B', and so on. The position of the displaced curve was found to depend upon the ratio of the magnitudes of the high frequency to the direct current in the specimen. When this ratio was decreased by decrease of the induced high frequency currents or by increase of the direct current, curves were obtained lying between those shown in the graph.

(2) (Fig. 1 (*b*)). Curve I represents the relation of the high frequency resistance and the temperature. When, in addition to the alternating current, direct current was applied to the specimen, curve II resulted.

When both currents were flowing, the critical point for the high frequency resistance was the same as the critical point for the direct current resistance; the position of this common critical point on the temperature scale is determined by the ratio of the magnitude of the direct to that of the alternating current. Thus, when the superconducting state had been established at this common critical temperature, resistance was offered neither to direct nor to alternating currents.

Two effects have therefore been established, the depression of the critical point for the direct current resistance by the application of high frequency currents, and the raising of the critical point for the high frequency resistance in the presence of a direct current. Full details of the experiments are in preparation for publication elsewhere.

These experiments confirm the reality of the frequency disturbance of the superconducting point found in our early experiments, and it follows that any theory of the nature of superconductivity that may be advanced must include an explanation of this new phenomenon.

J. C. MCLENNAN.
A. C. BURTON.
J. O. WILHELM.
A. PITT.

McLennan Laboratory,
Department of Physics,
University of Toronto, June 29.

[1] *Proc. Roy. Soc.*, A, **136**, 52; 1932.

Inter-Diffusion of Metals

WE have recently applied high precision X-ray analysis to the study of the inter-diffusion of two metals in the solid state. Although the experimental work so far has been confined to mixtures of copper and zinc particles (heated *in vacuo*), enough data have been obtained to show that this new method has distinct advantages over the methods hitherto employed, and that it admits of wide application. Its two principal features are: (*a*) the direct measurement of a fundamental quantity, namely, lattice parameter (or mean atomic volume), while, in other methods employed to study this phenomenon, mean values of such quantities as chemical composition, width of zones, electric resistance, thermoelectric effect have been determined; and (*b*) each phase present at any time gives its own X-ray reflection lines independently, from which its composition can be readily found from standard composition-parameter curves.

In Fig. 1, a series of prints from portions of X-ray

photographs is reproduced, in which the trend of inter-diffusion in a 70 per cent copper-zinc mixture, at 450° C., can be followed, for diffusing times varying from 10 minutes to 140 hours. The reflection lines from the different phases are clearly shown. During the early stages in the production of a phase, lattice distortion usually causes the reflection lines to be broad and unresolved ; but while the accuracy attainable in the mean parameter measurements is thereby somewhat impaired, it is considered that the composition derived from such measurements is still accurate enough for the present purposes. It may be added that the precision measurements are capable of giving parameter values to at least 1 in 4000, with good reflection lines on the most unfavourable positions on the film.

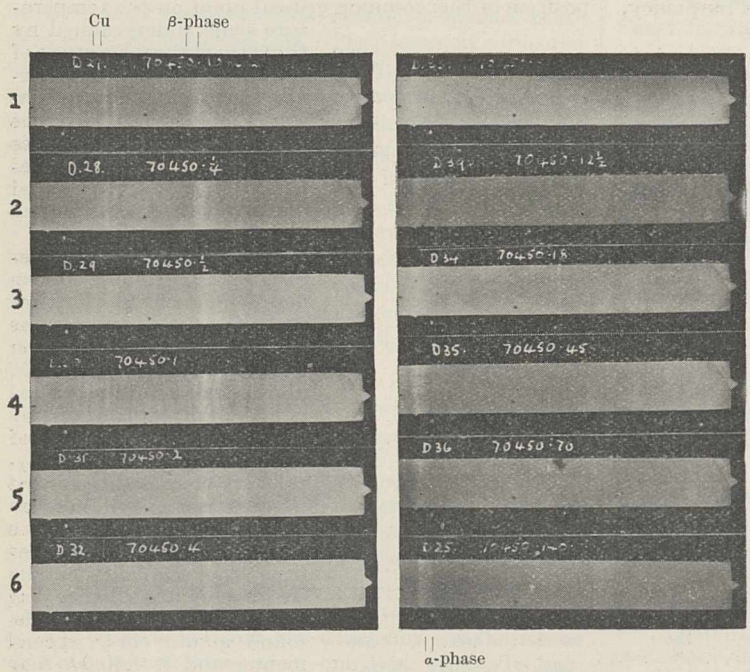

FIG. 1.—X-RAY PHOTOGRAPHS OF MIXTURES OF FILINGS OF COPPER AND ZINC CONTAINING 70 PER CENT COPPER HEATED AT 450° C. FOR DIFFERENT TIMES

Photo. No.	Time of Diffusion.	Parameter (in A.). Copper.	β-phase.	α-phase.	Photo. No.	Time of Diffusion.	Parameter (in A.). Copper.	β-phase.	α-phase.
1	10 min.	3·6079	2·947	—	7	8 hr.	—	2·943	3·688
2	¼ hr.	3·6079	$2·945_5$	—	8	12½ hr.	—	—	3·686
3	½ hr.	3·6079	$2·944_5$	—	9	18 hr.	—	—	3·685
4	1 hr.	3·6079	$2·943_6$	—	10	45 hr.	—	—	$3·680_5$
5	2 hr.	3·6079	$2·943_3$	—	11	70 hr.	—	—	$3·679_7$
6	4 hr.	—	$2·943_3$	$3·69_5$	12	140 hr.	—	—	$3·674_8$

Parameter of 70 per cent Cu-Zn Alloy = $3·674_3$

From a study of various series of data, similar to that in Fig. 1, there appears no doubt that the inter-diffusion of copper and zinc is entirely controlled by the thermal equilibrium diagram, the rate of diffusion in the various phases being different. Consequently, while our investigations had initially in view the study of the general laws of inter-diffusion in the solid state, it was realised that the copper-zinc system was too complex to attain the object satisfactorily.

The data obtained by using particles of different graded sizes showed, however, that the rate of diffusion at a given temperature was independent of particle size. Also, the fundamental law of inter-diffusion appears, and is put forward tentatively here, to be of the form $c_0 - c = \Sigma K e^{-mt}$, where c is the composition at time (t), c_0 the final composition, and K and m are constants depending upon the temperature at which inter-diffusion takes place, each phase present having a different set of constants. This relation is different from Weiss's law,[1] $dc/dt = 1/t$, which Ageew and Vher claim to have demonstrated experimentally.[2]

We hope to publish shortly a detailed account of this new development and the data obtained. At present, an investigation into the inter-diffusion of copper and nickel is being carried out by the method, as we anticipate that this latter system, owing to its simple solid solution constitution at all compositions, will eliminate certain complications and yield more definite and conclusive experimental data as regards the fundamental law of the inter-diffusion of metals in the solid state.

E. A. OWEN.
L. PICKUP.
University College of North Wales, Bangor, June 25.

[1] *Ann. Chimie*, **19**, 201; 1923: **20**, 131; 1923.
[2] *J. Inst. Met.*, **44**, No. 2, 1930.

'Protective' Adaptations of Animals

I AM sure that B. P. U. would not willingly misrepresent the opinions of those with whom he disagrees, yet he has done so when he refers to the existence of a common belief "that anything found in a bird's stomach would be in an unrecognisable state"[1]. I do not know of any naturalist who holds this opinion. B. P. U. has apparently extended into this sweeping statement the conclusion that the remains of butterflies eaten by birds soon become unrecognisable as Rhopalocera, except with the aid of the microscope. The history of this conclusion is interesting. In W. L. McAtee's earlier paper, "The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in Protecting Animals from their Enemies",[2] the following statement appears :

"Practically the only large body of authentic information on the natural food habits of birds is contained in the records of the United States Biological Survey. They comprise detailed identifications of the contents of more than 48,000 bird stomachs, representing all families of birds and collected in hundreds of localities in the United States at all seasons. The United States has a goodly representation of butterflies, yet only five of these 48,000 stomachs contained remains of Rhopalocera."

About the time when this paper was published, certain distinguished naturalists in Great Britain expressed the concurrent opinion that birds rarely attacked butterflies, and some of them stated that they had never, in all their experience, witnessed such an attack. Accordingly, those other naturalists who, on various grounds, had come to the conclusion that birds are the chief selective agents in the evolution and maintenance of butterfly mimicry, set to work to test the value of this negative evidence as well as the trustworthiness of McAtee's "authentic information". The result has been, in the first place, the accumulation

of a great body of direct and indirect evidence, and in the second, the proof, by C. F. M. Swynnerton and W. A. Lamborn, that butterflies, after being eaten by birds, are soon rendered unrecognisable save by the use of the microscope. The further result has followed that McAtee, although he attempts no explanation or defence of his earlier figures, now records the remains of butterflies (24 in the larval, 2 in the pupal state), in 113 out of 80,000 stomachs. To search with the compound microscope for butterfly wing-scales scattered through the contents of 80,000 avian digestive tracts would be a serious business, and if it had been accomplished I venture to believe that far more positive results would have been obtained.

Apart from butterflies and moths and some other specially delicate forms, it is well known, and, so far as I am aware, has never been disputed, that the group and sometimes even the species of insect is readily recognisable when present in a bird's stomach.

It would be inconvenient, within the scope of a letter, to make any further comment on McAtee's two papers and on B. P. U.'s other conclusions founded upon the second.[3] A detailed reply, now in course of preparation, will, it is hoped, appear in the near future.

EDWARD B. POULTON.

Oxford University Museum,
July 13.

[1] NATURE, July 9, 1932, p. 66.
[2] *Proc. Acad. Nat. Sci.*, Philadelphia, June 1912, p. 281.
[3] Smithsonian Miscellaneous Collections, vol. 85, No. 7, p. 201. Washington, 1932.

B. P. U.'s article on "The Value of 'Protective' Adaptations of Animals" in NATURE of July 9 demands some comment. The issue can only be finally settled by *ad hoc* experimentation; there has already been a certain amount of this, and on the whole it has given evidence of discriminative rejection of certain types.

That, however, can be dealt with by those more familiar with the details of the work than I am. I would here only like to point out what I believe to be a fundamental fallacy in the conclusions summarised by B. P. U.

The arguments put forward appear to be threefold:

(1) The number of insects found in birds' stomachs is proportionate to their numbers in Nature. The proportionality, however, is admitted to be rough only.

(2) Even groups which are usually said to be specially protected are eaten. "Some birds eat ants in very large numbers."

(3) Some organisms which are known to be poisonous are freely eaten, though this causes the death of their captors.

With regard to the first point, it is, I think, relevant to point out that if an inquiry were held we should doubtless discover that the number of ships of different type which are wrecked are *roughly* in proportion to their numbers, whether they are equipped with Diesel or steam engines, with this or that type of steering gear, this or that type of compass. Again, the number of war vessels of different types sunk by enemy gunfire during the War would doubtless prove to be roughly proportional to their numbers, irrespective of the thickness of their armour-plating. So long as the proportionality is rough, such facts have no relevance whatever to the question of whether the armour-plating, the type of compass, etc., have functional value for navigation. Even if the proportionality were exact, it would have little significance. All ships have to be 'adapted' to navigation in a number of ways if they are to survive the dangers of the sea at all: those that are 'worse adapted' in regard, for example, to compass or power, deliberately do not take such risks as others, but stick to coastwise traffic, and do not put out when 'better adapted' boats would not hesitate: their 'adaptation' is in their habits.

So with organisms. They all have to be adapted in a thousand ways if the species is to persist. With regard to avoiding their enemies, some do so by stressing protective coloration, others by protective and retiring habits, others by high fecundity, others by distastefulness, others by toughness, others by speed, etc. The avoidance of enemies is never perfect; but this does not in the least invalidate the fact that to achieve survival numerous adaptations have been necessary. We should also remember that a certain number of protectively coloured animals will of necessity be discovered, a certain number of warningly coloured ones eaten. The absolute number, and also the proportion, will increase with (*a*) the abundance of the species itself, (*b*) the hunger of the enemy species. This mechanism helps to produce the rough proportionality between abundance and number eaten; but it tells us nothing as to whether the total abundance would not have been quite different if the colour were not adaptive.

One has only to imagine an organism which was conspicuous in colour and in habits, sluggish, palatable, juicy and soft, and with a low fecundity. How long would the species survive? I take it, about as long as a type of ocean-going ship with no compass or steering gear.

A species is only adapted *to survive*, not to become immune from all enemies (which would, in any case, lead to destruction through over-multiplication); and each adaptation is relevant only in its particular way.

As regards point (2), it is a well-known fact that adaptation for protection is frequently met by counter-adaptation for attack. The fact that "some birds" (B. P. U.'s own words) eat ants freely does not imply that ants are not rejected, relatively or entirely, by most birds. To deny this is like denying that submarines are particularly immune from detection by most ships, on the ground that by special methods they can often be located and destroyed by depth charges.

Point (3) may or may not mean anything. Without precise investigation directed especially to the ecology of the species, it is impossible to say whether or not the poison or the distastefulness may not actually confer protection against other organisms than those which do eat them. This is really a variant of the answer to point (2). Some plants are in general poisonous, and appear to be therefore immune from being used as food by most insects; but they are eaten by insects which possess a special immunity (cf. certain Papilios).

In general, the fallacy is that of forgetting that no species of organism could exist which was not a bundle of adaptations, but that each particular adaptation is partial and relative.

JULIAN S. HUXLEY.

King's College, London.

Degenerative Mutations

IN Mrs. Sexton's important paper[1] on "Degeneration and Loss of the Eye in the Amphipod *Gammarus chevreuxi*" she makes one remark which, in its suggestion of theoretical controversy, is in striking contrast with the mass of details of observation, and minute records of genetical facts, of which the rest of the paper consists. The sentence to which I refer is: "In view of all that has been written on the origin of the blind fauna, it is a significant fact that blind animals could be produced within the limits of a single species in such a short time and in so few generations".

This means, apparently, that the blindness of cave

animals has not been gradually evolved under the influence of darkness, but is the result of degenerative mutations of the same kind as those described in Mrs. Sexton's paper. She describes a series of retrogressive mutations, red-eye in 1912, albino-eye in 1915, 'spotted', and one-eye and no-eye in 1920. The absence of one or both eyes occurred among the descendants of a single mating in which the three earlier mutations were combined. In the latest degenerations, the shape of the head was frequently altered; in some cases the first antennæ were absent, the shape of the brain was abnormal, and finally there was a marked degeneration in the reproductive organs, many individuals being sterile and others intersexual. No such progressive degeneration in many directions has been shown to occur in the blind Crustacea or blind animals of other classes in the cave fauna, or in *Gammarus chevreuxi* itself in the wild state.

I would suggest that Mrs. Sexton's stock of *G. chevreuxi* offers a much closer and more obvious analogy to Japanese goldfish in their monstrous abnormalities than to blind cave animals. In both the former cases, the degenerative mutations occur in animals kept in close confinement under abnormal and unhealthy conditions, and it seems reasonable to conclude that such conditions are the real cause of the so-called mutations. Vigorous and normal development depends on normal conditions. The normal genes do not live a charmed and invulnerable existence; the evidence suggests that they are altered and enfeebled by confinement, by impurities and deficiencies in the surrounding air or water and in the diet, by want of exercise, with the result that in the course of generations their power to determine normal and vigorous development is enfeebled and all kinds of deficiencies and abnormalities appear and increase until the strain dies out. As Mrs. Sexton herself says, "the farther removed from the normal an animal is, the lower its viability".

Thus it seems to me that the significant fact is, not that blindness may be produced without the influence of darkness and that therefore the blindness of cave animals has not been due to the absence of light, but that degenerative and hereditary mutations are caused by the abnormal conditions involved in keeping animals confined in small vessels inside a laboratory for a long series of generations, and that further degeneration is produced by combining such mutations by interbreeding.

J. T. CUNNINGHAM.
35 Wavendon Avenue,
London, W.4, July 2.

[1] *J. Mar. Biol. Assoc.*, May 1932.

Cytological Differences between Closely Allied Species

IN 1931 [1] I described important differences between the watery, neutral, red-staining vacuoles of the eggs of *Rana tigrina* and *Rana cyanophlyctis*. For details references may be made to the original paper, but the most important difference is in the size of the vacuoles, those of *tigrina* measuring as much as 0·02 mm. in advanced oocytes, whereas those of *cyanophlyctis* are very much smaller.

In the course of certain experiments carried out last summer on the eggs of a large number of animals with Sudan III. and Scharlach R. to determine the exact time when the lipoidal Golgi elements become fatty, it was discovered in *R. tigrina* that the fatty yolk, which had been reported by me in 1931 to be absent in the biggest egg (1·08 mm.) then studied, actually puts in its appearance when the egg measures 1·2 mm. From this stage up to 1·5 mm. (the biggest egg I have ever examined in this species) the fats stain deeply with the above dyes, but no red granules appear in younger oocytes. In *R. cyanophlyctis*, on the other hand, the Golgi elements become fatty when the oocyte measures a little more than 0·5 mm.

In 1931 I sounded a note of caution as to "how discordant results can be arrived at by two workers investigating two species of the same genus". I added that "if I had not first studied the big vacuoles of *tigrina* I might have perhaps failed to notice those of the other species. I imagine that the British and European frogs in which no vacuoles have been described are like *cyanophlyctis*."

That is exactly what has actually happened. Prof. Saguchi,[2] working on the eggs of *Rana nigromaculata*, confirms most of my conclusions, but finds that there is no vacuole and that fat appears when the egg measures 0·3 mm.

I would like to recommend the eggs of *R. tigrina* to all teachers in India running cytology courses for demonstrating the Golgi elements, the mitochondria, and the vacuolar system in fresh oocytes without the aid of any vital dye. The most favourable stage for this is when the oocyte measures about 0·45 mm. In the highly advanced oocytes there is a well-developed cortex containing the vacuoles. This can be easily separated for demonstration.

VISHWA NATH.
Department of Zoology,
Government College, Lahore, June 9.

[1] *Zeit. Zellf.*, 1931.
[2] "Zytologische Studien", 1932.

The Inheritance of Acquired Characters

PROFS. MACBRIDE and Harrison have devoted some space to refuting a number of statements which I have never made.[1] "He suggested in his discourse that Harrison's strain of sawflies had become contaminated with a strain adapted to the new willow", writes Prof. MacBride. As the discourse is printed in NATURE of June 4 and 11, it is easy to verify the fact that I made no such suggestion. Nor have I ever made any of the criticisms found in Prof. Harrison's last paragraph. I was, however, quite aware of the facts of which he accuses me of lack of knowledge. They would doubtless have been relevant had I made the statement attributed to me above.

Perhaps the somewhat imaginative manner in which Prof. MacBride has dealt with my discourse will make readers of NATURE cautious in accepting his interpretations of the work of Dürken, Metalnikoff, and others.

J. B. S. HALDANE.
Roebuck House, Cambridge.

[1] NATURE, **130**, 128, July 23, 1932.

A Reinterpretation of Relativity

THE theory of relativity is an undeniable achievement in physics and is a logical development of the theory of measurement; but it does not have the significance for the universe which is usually ascribed to it. Real time is *not* fused with space, and *absolute simultaneity does have a definite and definable meaning.*

Physics as a science is concerned with measuring and dating and so getting numerical laws. All this gives knowledge about the external world. But it would be a mistake to project this measurational knowledge into Nature without interpretation. The rejection of absolute simultaneity as meaningless has encouraged most relativists to do this.

My analyses have led me to make a distinction between *chronological time* and *real time*. Chronological time is an affair of dating and measuring in terms of some standard motion. Real time is the fact of change, or eventness. I hold that absolute simultaneity has meaning for real time, while operational simultaneity, which is the kind that relativity stresses,

is bound up with light-signalling. When two bodies are moving with respect to one another, their operational simultaneities are not identical. It follows that length (space) and t (chronological time) as numerical quantities always require a reference to the frame from which the measurements are made. It is for this reason that physicists speak of space-time. They mean that length and t as quantities are not separable.

I have no criticism to pass upon this so long as measurement is not confused with what is being measured. Measurement gives knowledge about Nature. The philosopher—and I hope the physicist also—needs likewise to think clearly about the structure of Nature. It is here that the question of the real nature of time appears. Is the Astronomer Royal's time—to use Eddington's expression—as basic as supposed? I take it that physicists like Jeans, Eddington, and Millikan are aware of this problem.

It is my thesis that real time is simply the fact of change or eventness in the universe and is always local. There is no change which runs instantaneously across the universe. The unity of the universe is spatial rather than temporal, and is of the nature of substantial coexistence and continuity. Nevertheless, it is correct to speak of a cosmic time if we simply mean the *class of events* coactual with any given event. In real time, simultaneity is the fact of co-occurrence and is not a kind of cosmic temporal relation. It is in this sense only that the universe moves abreast. Past events are those which have perished and are no longer actual. Future events are those which are not yet actual. *Simultaneous events are just the class of actual events.* This is what the philosopher and the physicist must mean by absolute simultaneity. But the physicist has a job of an empirical sort which the philosopher does not have: that of dating and measuring. The job of the philosopher is essentially that of analysis of categories. For him, real time involves the order of succession and the class of actual events in the universe. He is as much opposed as the modern physicist is to Newtonian conceptions of time.

It follows that the fusion of space and time must not be taken as valid for anything but chronological knowledge about Nature. In Nature itself, only the actual exists. I am also led to believe in determinate size apart from measurement. Quantities are cases of knowledge about and are relative to a frame; but not so the intrinsic properties of things. I am also led to believe in gravitational forces and to distinguish them from the kinematic description in terms of space-time. It follows also that relational movements have meaning as well as relative motion. Relational movements are changes of neighbourhood, while relative motion is an affair of epistemic reference, which presupposes actual movement.

Finally, so far as I can see, cosmic time has no arrow of an entropic sort. It is merely the fact of dispersed change in a substantial, extended world. I expect to find that Millikan, Lewis, and Bridgman will turn out to be right in their criticism of the application of entropy to the universe.

ROY WOOD SELLARS.

Department of Philosophy,
University of Michigan,
Ann Arbor.

The Absorption Spectrum of Hexuronic Acid

As part of a systematic study [1] of Prof. Szent-Györgyi's 'hexuronic acid' we have investigated quantitatively the absorption spectra of hexuronic acid, glycuronic acid, galacturonic acid, tetramethyl γ-fructose, and other carbohydrate derivatives. In view of the fact that hexuronic acid has been identified with vitamin C,[2] we have paid special attention to the possibility of contamination by small traces of impurity. We find that the single broad band at about 263 mμ reported qualitatively by F. P. Bowden and C. P. Snow [3] is found in equal intensity with the sample of hexuronic acid supplied by Prof. Szent-Györgyi and with rigorously purified material. It appears, therefore, that this band is definitely associated with hexuronic acid. The nature of the band in methyl alcohol (*c.* 0·002 per cent) is indicated by the accompanying table:

Mol. Extinction Coefficient (ε).	Wave-length (mμ).
1000	295
2000	220, 290
3000	228, 285
4000	235, 280
5000	241, 278
6000	245, 272
7000	254, 268
7500	263

Marked deviations from Beer's law were observed, the solutions becoming relatively less transparent on dilution. For example, at 280 mμ the molecular extinction coefficient has the values 800, 2000, and 4400 for solutions of concentration 0·02, 0·005, and 0·002 per cent respectively. Dilute methyl alcoholic solutions of hexuronic acid are unstable and show, when kept, a gradual diminution in the intensity of the band.

In water a single broad band is displayed at 260 mμ. The value of ε is about 7000 for freshly prepared solutions (*c.* 0·002 per cent), but in this solvent a rapid diminution in the intensity takes place, ε falling to 4000 within three hours.

The absorption of hexuronic acid resembles that of many ketonic substances, but differs completely from that shown by aldose or ketose sugars of the pyranose type,[4] which show no absorption bands. We have now proved that a typical keto-furanose sugar (tetramethyl γ-fructose) shows no selective absorption. Similar results were obtained with glycuronic acid and with galacturonic acid. All these substances are highly transparent in water and display weak continuous absorption, with ε in each case less than 5 at 260 mμ.

The tentative formula for 'hexuronic acid' previously suggested [5] envisages a possible keto-furanose sugar structure with the carboxyl group in position 6. In view of the above results, it seems improbable that such a structure would account for the absorption band observed with hexuronic acid, and some rearrangement of the formula may therefore be necessary. Experiments to decide this are now well advanced.

R. W. HERBERT.
E. L. HIRST.

Chemistry Department,
University of Birmingham,
July 1.

[1] E. L. Hirst and R. J. W. Reynolds, NATURE, April 16, 1932, p. 576.
[2] J. L. Svirbely and A. Szent-Györgyi, *ibid.*, p. 576.
[3] NATURE, May 14, p. 720.
[4] L. Kwiecinski and L. Marchlewski, *Bull. Acad. Polonaise*, 1927, 379.
[5] NATURE, April 16, p. 576.

Crystalline Structure of Hexuronic Acid

FROM a purified specimen of 'hexuronic acid' (identified by Szent-Gyorgyi with vitamin C) available in this laboratory I have been able to obtain sufficiently good crystals to carry out an X-ray examination by the single-crystal rotation method. The substance is monoclinic sphenoidal, with $a = 17{\cdot}71$, $b = 6{\cdot}32$, $c = 6{\cdot}38$ A., and $\beta = 102\frac{1}{2}°$, while the space-group is C_2^2 ($P2_1$), since the only true halving is

($0k0$) absent when k is odd. The density of the crystals was determined by the flotation method to be 1·65 gm./c.c., so that there are four molecules of $C_6H_8O_6$ in the unit cell. Since C_2^2 has only twofold symmetry, a pair of molecules must be associated to form the asymmetric crystal-unit. (This does not necessarily imply polymerisation.)

On examination microscopically, the crystals are found to be tabular on (100), usually almost square, and exhibiting pronounced cleavage parallel to (010). The birefringence is very high and negative, the refractive indices being $\alpha = 1{\cdot}464$, $\beta = 1{\cdot}68$ (approx.), and $\gamma > 1{\cdot}70$, with α parallel to the b-axis. These results indicate that the molecules are nearly flat and lie in the (010) plane. The birefringence ($>0{\cdot}24$) is much higher than any so far observed among the carbohydrates or their derivatives, although that of γ-mannonolactone is about half this amount. This suggests that the hexuronic acid molecule has a ring structure with fewer groups projecting out of the plane of the ring than a normal carbohydrate, and contains double-bonds, possibly in carbonyl groups. The X-ray results are in agreement with these conclusions; the thickness of the molecule must be $\frac{1}{2}\,b$, that is, 3·16 A., which is considerably less than that of any carbohydrate so far examined, indicating a flatter molecule, while the regular falling off of the intensities of the {020} reflections also requires a fairly flat molecule parallel to (010).

A very interesting feature of the X-ray results is that unless very long exposures are given, the photographs show no reflections from ($hk0$) planes for which h is odd. This indicates an almost perfect glide-plane of symmetry perpendicular to the c-axis, and therefore a pseudo-plane of symmetry in the molecule itself, at right angles to the plane of the ring. Since carbon and oxygen have nearly the same volumes and scattering powers, such an arrangement can occur without destroying the optical asymmetry of the molecule.

Optical examination and X-ray powder photographs show that the purified hexuronic acid is identical with the crystalline portion of the original substance obtained from Prof. Szent-Gyorgyi. (The amount of impurity in the latter is apparently quite small.)

A more detailed account of this work will be offered for publication in due course. I am indebted to Dr. E. L. Hirst for supplying the purified material and for numerous helpful discussions.

E. G. Cox.

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July 18.

Anaerobic Activation of Glycolysis in Tumour Tissue

ROSENTHAL[1] has shown that when the anaerobic conversion of fructose to lactic acid by the Jensen rat sarcoma is studied by Warburg's method, a spontaneous increase in the rate of acid production ($Q_M^{N_2}$), which he ascribes to the anaerobic formation of an activator, occurs about forty minutes after the manometric vessels are put into the thermostat at 38° C. We have been able to show that this spontaneous increase may also be demonstrated when glucose is the substrate, although here the pre-activation period is shorter; and we find that with both sugars the pre-activation period is abolished when sodium pyruvate is present in 10^{-3} M concentration.

Sodium pyruvate was stated by Mendel, Bauch, and Strelitz[2] to increase the anaerobic fermentation of glucose by normal body tissues. We find that when sodium pyruvate is added, by tipping from a side bulb, to Jensen rat sarcoma in fructose-containing Ringer solution during the period preceding the spontaneous increase of anaerobic fermentation, $Q_M^{N_2}$ rapidly rises and remains constant at approximately the value which would eventually have been reached by the spontaneous activation; whereas after this latter has occurred, addition of sodium pyruvate has no effect (Fig. 1 (i)). Further, the Mill Hill fowl tumour, although attacking fructose with about the same vigour as the Jensen sarcoma, does not show this spontaneous rise in lactic acid formation, and in this case sodium pyruvate shows no action.

A spontaneous increase of rate of lactic acid formation from glucose is not ordinarily observed with the Jensen rat sarcoma. We find, however, that if the tumour slices be suspended anaerobically at 38° C. for

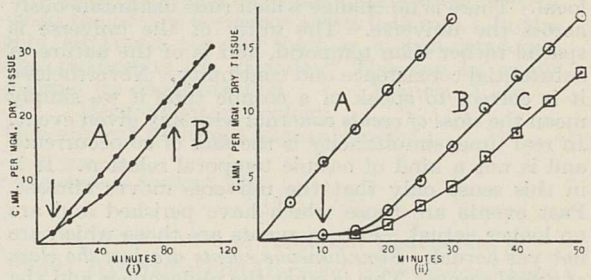

FIG. 1.—Lactic acid production by Jensen rat sarcoma, (i) in 0·2 per cent fructose solution; *A*, pyruvate added at 10 min.; *B*, pyruvate added at 85 min. (ii) *A*, glucose present from start; *B*, glucose and pyruvate added at 10 min.; *C*, glucose only added at 10 min.

20 minutes in sugar-free Ringer solution in the manometric vessels and glucose be then added from the side bulb, a preliminary de-activation results which allows a spontaneous re-activation to be observed. For after glucose addition, $Q_M^{N_2}$ does not immediately rise to its final value, but stays at a steady intermediate value for about 15 minutes and then rises rapidly to its steady final level. The presence of 10^{-3} M sodium pyruvate in the solution, or its addition together with the glucose, abolishes this preliminary period, $Q_M^{N_2}$ rising rapidly to the final value very soon after the glucose is added. Addition of 10^{-3} M pyruvate to the solution when glucose is present from the start causes no increase in the anaerobic lactic acid formation (Fig. 1 (ii)).

It thus seems that sodium pyruvate may replace the anaerobic activator in partially activated tissues, but has no effect when the activation is complete. The detailed results will be published in due course.

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G. D. GREVILLE.

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Middlesex Hospital,
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July 22.

[1] *Z. Krebsforschung*, **32**, 220; 1930.
[2] *Klin. Woch.*, **10**, 118; 1931.

Anomalous Adsorption on Active Charcoal

AT the recent discussion of the Faraday Society on the "Adsorption of Gases on Solids", Prof. A. J. Allmand and his co-workers [1] presented a summary of their investigations on the discontinuities they have found in adsorption isotherms for gaseous adsorptions.

They also referred to unpublished evidence, obtained by Chaplin, for the discontinuous adsorption of phenol from aqueous solutions on an active technical charcoal. This statement apparently refers to an investigation the details of which have now been published.[2] Of the three isothermals obtained, Chaplin prefers to place reliance upon the third one, the other two being inaccurate for the reasons discussed by the author himself. Chaplin has drawn an isothermal curve through the experimental points which exhibits marked discontinuities. It appears, however, that the curve has been drawn in an arbitrary manner, and a smooth adsorption isotherm can be obtained within the experimental error, only one point being markedly off the curve.

If the existence of discontinuities could be clearly substantiated, then this must lead to a reconsideration of current adsorption theories. With the hope of throwing some light on the subject, it was decided to

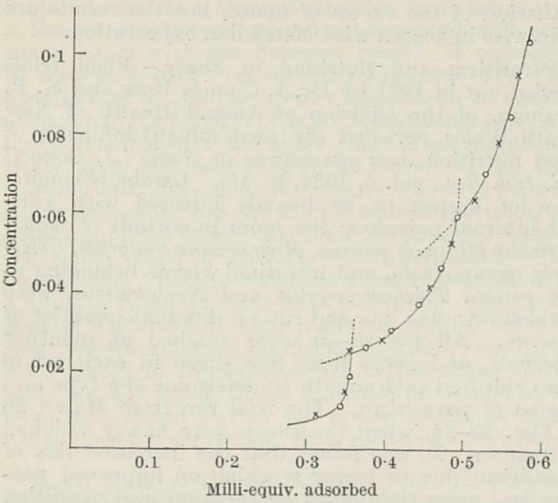

FIG. 1.—Curve showing the quantity of phenol adsorbed (milli-equivalents) from 25 c.c. solution per gm. of charcoal as a function of the concentration (milli-equivalents in 25 c.c.).

repeat Chaplin's work, employing another and probably more accurate method of analysis. The adsorbent used was an oxygen (atmospheric) activated ash-free sugar charcoal which has been employed previously,[3] and the concentrations of the phenolic solutions were determined with a Zeiss interferometer; the phenol used had been purified by repeated fractional distillation. A very unusual adsorption isotherm (25°) was obtained (Fig. 1) with two series of measurements. No discontinuities of the type postulated by Allmand and his co-workers have been found, but the isotherm is composed of three distinct curves, each of which appears to extrapolate back to the origin.

Several interesting possibilities present themselves, but it is desirable to investigate the phenomena more intensively before a detailed discussion is entered upon. It is, however, worth pointing out that each of the curves, when treated independently, conforms to the adsorption theory of Langmuir.

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King's Buildings,
University of Edinburgh,
June 30.

[1] *Trans. Far. Soc.*, **28**, 218; 1932.
[2] *J. Phys. Chem.*, **36**, 909; 1932.
[3] *J. Chem. Soc.*, 613; 1932.

Effect of Carbon Monoxide on the Biological Reduction of Nitrate

THE reduction of nitrate is accomplished by cells of very diverse types—plant, animal, and bacterial. A thermolabile catalyst controls the activation of nitrate, though cases are known where apparently nitrate may be reduced by biological means without the intervention of a specific catalyst.[1] The distribution of the nitrate oxidase, as the catalyst may be conveniently termed, seems to be very haphazard; it occurs in the livers of most animals, but nitrate reduction in muscle is confined to the rat and guinea-pig. Among the bacteria, it is absent from obligate anaerobes and aerobes, but it occurs in most faculative anaerobes. With these organisms nitrate serves as an oxidising source and will enable anaerobic growth to occur in its presence.[2] The nitrate oxidase is present in *B. coli*, the ability of which to reduce nitrate to nitrite has been made a test of its presence in biological fluids. The activity of the enzyme is greatly inhibited by traces of hydrogen cyanide,[3] but if a suspension of *B. coli* which has been exposed to quite a high concentration of hydrogen cyanide is well washed with saline the organism regains its ability to activate nitrate.[4] The effect of cyanide on nitrate oxidase is thus reversible.

Preliminary experiments, carried out recently in this laboratory, now indicate that carbon monoxide has a small but definite inhibitory action on the reduction of nitrate by *B. coli*, the inhibition apparently being greater the smaller the quantity of nitrate present.

Nitrate reduction by *B. coli* in presence of a suitable donator is not only inhibited by carbon monoxide but also by oxygen, the effect with oxygen being far greater than with carbon monoxide. From the facts available so far, it would seem that nitrate, carbon monoxide, and oxygen all compete for the nitrate oxidase, and the inference would be that the enzyme belongs to the iron-containing class of molecule which has been described as responsible for the activity of peroxidase, catalase, and the indophenol oxidase. Further investigation is necessary to decide whether this is the case.

There is some evidence that the chlorate oxidase of *B. coli* is inhibited also by oxygen and carbon monoxide.

Details of this work will be published in due course.

J. H. QUASTEL.

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[1] Bernheim and Dixon, *Biochem. J.*, **22**, 125; 1928.
[2] Quastel, Stephenson, and Whetham, *Biochem. J.*, **19**, 304; 1925.
[3] Loffler and Rigler, *Biochem. Z.*, **173**, 449; 1926.
[4] Quastel and Wooldridge, *Biochem. J.*, **21**, 1234; 1927.

Zoological Nomenclature

IN accordance with prescribed routine, the undersigned invites the attention of zoologists to the fact that application has been made to the International Commission on Zoological Nomenclature to suspend the Rules and to place in the Official List of generic names:

Lepidocyclina Gümbel, 1868, type (1898) *Nummulites mantelli*; objective synonym *Cyclosiphon* Ehrenberg, 1856, type *N. mantelli*; *Lytoceras* Suess, 1865, genotype *Ammonites fimbriatus* Sowerby; and *Ophiceras* Griesbach, 1880, genotype *O. tibeticum* Griesbach.

These cases will be held open until about July 1, 1933, to enable zoologists to submit to the Commission their opinions, for or against the proposition.

C. W. STILES,
Secretary.
Hygienic Laboratory,
Washington, D.C.

Research Items

English Folk-Dances.—Miss Maud Karpeles has published in *Folk-Lore*, vol. 43, No. 2, a study of the survival and revival of folk-dances, in which she reviews the principal types of folk-dance with special reference to the study of their meaning as a borderline province for the folk-dancer and the folk-lorist. The sword dance, which has survived in Yorkshire, Northumberland, and Durham, is danced by five men, or in Yorkshire by six or eight men, usually accompanied by additional characters, the 'fool', the 'king', 'queen', and 'Bessie'. The sword in Yorkshire has a wooden handle at one end but in Durham is a piece of flexible steel with a handle at each end. In the climax of the dance the swords are woven into a 'lock', 'nut', 'rose', or 'glass', and one character suffers a mimic decapitation. There are several features in the dance as it was sometimes performed which point to a play from which it has become detached. Fragments of the play have been noted and, like the mummer's play, it is evidently of a ritual character, a fertility rite of which an animal sacrifice once formed part. The other main type of spectacular dance is the morris, for the name of which the best derivation up to the present seems to be 'Moorish', as referring to the blackened faces of the dancers in earlier times, of which traces survive in a smudge of black worn by some dancers in recent times. The morris may be an offshoot of the sword dance. There is, however, no trace of the sacrificial victim, though there are signs of a sacrificial or sacramental rite which are not embodied in the dance itself. It may be a processional lustration dance in which the stationary dance at certain spots has been elaborated at the expense of the processional.

Ritual Use of Fire in Queensland.—Mr. Donald F. Thomson describes in *Man* for July some ritual uses of fire among the Koka Dai'-yuri and other tribes of the lower Edward River, Gulf of Carpentaria, among whom social life differs little except in detail. As a centre of family life, fire establishes or affirms a bond of solidarity between individuals or within the group. Each family has its own fire, and family life centres around it. Of the two camps consisting of the single men and single women respectively, each has its own fire; and however intimate may be relations, no individual from outside the family joins the family fire; he has his own fire, though it may be only a few yards away. In the Ompela tribe, the simple act of sharing a fire in the presence of the camp constitutes the marriage ceremony. At the critical stages of life when an individual is cut off from participation in normal social activities, he or she camps at a fire apart from others. Fire is presented ceremonially to visitors. On approaching the camp they sit down outside until a 'big' man unarmed has sat down opposite them and then after a period has ordered a small piece of smouldering fire to be brought from the camp and presented to one of them. They then enter the camp. Fire is also used ceremonially in connexion with mourning and burial rites. After the body or bones of the deceased have accompanied the mourners for a period of two or three years, and the time has come to end the mourning, the body is laid in the dry bed of a river and a fire lighted at its head, while food and a small trough of water stand by. After a dance by the women and laments from the men, the mourning paint is washed off and the fire extinguished with the water from the trough, as all lament loudly.

Inheritance of Alkaptonuria.—So early as 1902, it was suggested that alkaptonuria is determined by a recessive Mendelian factor. The condition is apparently due to the absence of an enzyme which catalyses the destruction of homogentisic acid in the human body, with the result that this substance is excreted in the urine. In an analysis of all the accumulated evidence, Messrs. Hogben, Worrall, and Zieve (*Proc. Roy. Soc. Edin.*, **52**, Part III., No. 13) have summarised all the known pedigrees and confirm the above conclusions. The condition is very rare, being estimated to occur less frequently than 1 in 1,000,000 of the population. While it is recessive in a large majority of pedigrees, it occurs as a dominant in certain families, and particularly in one pedigree of four generations. One case of its probable origin by mutation is also recorded. The total number of recorded cases is now 151, of which 100 are males and 46 females. There is at present no satisfactory explanation of the excess of males, but the results are otherwise in accord with Mendelian expectation.

Parasitism and Nutrition in Sheep.—Field trials carried out in 1931 by Dr. I. Clunies Ross and N. P. Graham, of the Division of Animal Health of New South Wales, revealed the predominant influence of good nutrition over parasitism in sheep (*J. Council Sci. Ind. Res.*, vol. 5, 1932, p. 31). Lambs belonging to a lot known to be heavily infected with various internal parasites, the more important of which were the stomach worms, *Hæmonchus contortus*, *Ostertagia circumcincta*, and intestinal worms belonging to the genera *Trichostrongylus* and *Nematodirus*, were divided into five lots and run on different qualities of pasture. All the sheep were weighed at monthly intervals, and fæces from five sheep in each group were cultured each month to determine the type and degree of parasitism. The trial ran from March 26 to Oct. 23–24, when the sheep were finally weighed and shorn. It was found that the increased risk of parasitism due to heavy stocking on improved pasture was more than offset by the improved condition of the sheep run on such pastures. The difference between the produce of un-top-dressed natural pasture and of improved pasture without rotation (at $2\frac{1}{2}$ sheep an acre) amounted to 18 lb. 5 oz. of wool and 83 lb. 7 oz. of live weight per acre, and still further gains were recorded where a monthly rotation was in force. Medicinal treatment against internal parasites produced no demonstrable effects in treated sheep in comparison with untreated sheep under the same conditions on improved pasture. Indeed, at the end of the trial, practically all worm infestation appeared to have been thrown off by sheep on improved pastures, whether the animals had been treated or untreated.

Mammal Coloration Simulating Environment.—In 1929, L. R. Dice described two pocket mice and a wood rat from New Mexico, the colours of which strikingly matched those of their rather peculiar and distinctive surroundings. A further study of the distribution of these forms, carried out by Seth B. Benson and two colleagues in the Tularosa Basin and the neighbourhood, has discovered three more rodents which tend to match the colour of the lava fields on which they live and to which they appear to be restricted. These new subspecies, which have been named *Citellus grammurus tularosæ*, *Perognathus intermedius rupestris*, and *Peromyscus nasutus griseus*, have not reached the degree of blackness of the lava-dwelling wood rat and pocket mouse, but appear to be intermediate stages between the ordinary colour and the black stage. They are described, with two plates, by Benson (*Univ. California Pub. Zool.*, vol. 38, 1932, p. 335).

Irish Euphausians.—Miss Winifred E. Frost in her work on the reproduction of *Nyctiphanes couchii* and *Meganyctiphanes norvegica* from off the south coast of Ireland (*Proc. Roy. Irish Acad.*, vol. 40, Sec. B, No. 14, 1931) investigates the breeding seasons of these euphausians and finds the larvæ of *Nyctiphanes* throughout the year with an April maximum. It probably has a spring and an autumn brood, whilst *Meganyctiphanes* apparently breeds in spring and summer with only one brood. As both these species, including the larvæ, form a large part of the food of herring, mackerel, and young hake, a detailed knowledge of their life histories is very important, and Miss Frost's observations give us some valuable information concerning the seasonal distribution of the larvæ. The area investigated lies off the south coast of Ireland and extends for about one hundred and fifty miles north and south, and for approximately two hundred miles from east to west, including both inshore and offshore waters. The main material consists of vertical plankton hauls taken with a Nansen net of two types, supplemented with occasional hauls with the Petersen trawl. It represents 31 cruises, spread over eleven years (1920–31). The distribution of the two species appears to be similar, although in the English Channel *Nyctiphanes* is usually found much nearer the coast than *Meganyctiphanes*. Both larvæ and adults occurred at one of the Irish stations with a depth of 150 metres. These two, both larvæ and adult, are the most frequent species in the plankton of the waters less than 100 fathoms deep off the south coast of Ireland, the distribution of the larvæ being 'patchy' without regard to depth or to a salinity range of 34·8-35·5 per mille. Only very general observations were made on vertical distribution, but the author found that the bulk of the calyptopis stages of *Nyctiphanes* are in the upper waters both day and night, whilst the older larvæ and adults were more abundant in the upper waters at night, which agrees with similar observations at Plymouth.

Fossil Marsupial from Africa.—Prof. E. Stromer, of Munich, has just described the first fragments of a fossil marsupial mammal from Africa (*Sitzungsb. Bayer. Akad. Wiss., math.-naturw. Abt.*, 1931 [1932], p. 177). They are portions of a lower jaw from a Middle Pliocene river-deposit south of Port Nolloth, Little Namaqualand, South Africa, and belong to an animal about as large as an ordinary rat. The dentition is sufficiently well preserved to show that the newly discovered species must have been closely related to the diprotodont marsupial *Cœnolestes*, which now lives in South America, and is represented by several extinct allies in the Tertiary rocks of Patagonia. The African form is generically distinct, and is named *Palæothentoides* by Prof. Stromer, who remarks on the interesting geographical distribution of the cœnolestid group of marsupials which is thus extended.

Wood Anatomy in Mangrove Swamps.—Alexis J. Panshin has studied the Philippine mangrove swamps from a new point of view (*Phil. J. Sci.*, vol. 48, No. 2, June 1932). The trees found in these forests belong to very different families, but are all growing in a remarkably uniform and very characteristic habitat. Panshin, therefore, studied the anatomy of these woods to see whether their common structural feature suggested a direct connexion between habitat and anatomy. All of the woods were typically diffuse-porous and the vessels had usually comparatively small diameter. Apart from these two features, great diversity of structure was represented amongst the large number of species examined, and the author concludes, in agreement with Solereder, that habitat does not impress any definite type of anatomical structure upon species with a different evolutionary history.

Hypal Fusions in Dermatophytes.—Prof. A. H. R. Buller and his colleagues have devoted much attention to the study of hyphal fusions in various fungi. They have now turned their attention to a practical application of this knowledge ("Hyphal Fusions in Dermatophytes", by A. M. Davidson, Eleanor S. Dowding, and A. H. R. Buller, *Canadian Journal of Research*, vol. 6, No. 1, pp. 1-23, 1932). Studies on species of *Microsporon* and *Trichophyton*, which cause sores upon the skin and hair of human beings, have been made. It was found that hyphal fusions formed between any two mycelia of the same species isolated from different patients, but did not form between the hyphae of two different species. A simple method of hanging-drop culture was used to compare the behaviour of an undetermined fungus with that of a stock culture. This method gave a trustworthy criterion for the identification of species, and may prove of great use in the treatment of human skin diseases.

Earthquake Frequency at Kilauea.—The *Volcano Letter* for Feb. 4, issued at the Hawaiian Volcano Observatory, contains a remarkable curve representing the seismicity of Kilauea during the past four years. In estimating seismicity, shocks of intensities 1, 2, and 3 of the Rossi-Forel scale are given the weights 1, 2, and 3, very feeble shocks the weight $\frac{1}{2}$, and tremors that scarcely show on the seismograph records the weight $\frac{1}{4}$. The number of tremors are occasionally very great, for example, 6531 and 10,080 during the weeks ending last Dec. 28 and Jan. 4, and, to keep the curve within reasonable limits, the logarithms of the weekly figures of seismicity are used. The outstanding features of the curve are the high peaks of suddenly increased activity that accompanied the four outbreaks of Halemaumau on Feb. 28 and July 25, 1929, Nov. 19, 1930, and Dec. 23, 1931, eruptions that were progressively more intense and lasting. The small oscillations tend to recur at intervals of from two to six weeks, with an average of 3·4 weeks.

The Granular Theory of Matter.—Volume 75 of *Memoirs and Proceedings of the Manchester Literary and Philosophical Society* contains the Dalton Lecture delivered before the Society by Sir J. J. Thomson on the occasion of his receipt of the Dalton Medal of the Society for his "eminent services to science", on March 17, 1931. The lecture was entitled "Atoms and Electrons", and in it Sir Joseph showed how the discovery that an electron moving with velocity u is always accompanied by waves of length equal to the quotient of Planck's constant h by the momentum mu of the electron, and of frequency proportional to the energy of the electron, had led him to the theory that matter was composed of granules of mass μ, less than 3×10^{-27} gm., all moving with the speed of light, the force on any granule being always at right angles to its path and producing therefore no change in the energy of the granule. When lines of electric force connecting protons and electrons link these granules together, the combination constitutes matter, and the mass of the proton or electron is the sum of the masses of the granules gripped by its lines of force, and the energy the sum of their energies. Further, if each granule is exposed to a succession of impulses ν_0 per second, the time of the impulses for each granule being arbitrary, for a mass m having m/μ granules the frequency ν of the disturbances will approximate closely to $\nu_0 m/\mu$ and the energy of the mass to $\nu\mu c^2/\nu_0$, which if we write h for $\mu c^2/\nu_0$ gives Planck's law.

Liquid Helium.—Prof. J. C. McLennan and some collaborators have published in the June number of the *Philosophical Magazine* some interesting photographs of liquid helium. The liquid was very quiet, and had a meniscus with an almost negligible curvature at the edge and scattered very little light. Examined for Raman spectra, it was found to exhibit no isolated modified lines; the intensity of any possible Raman line was certainly fainter than the weakest Raman line observed in the spectrum of the light scattered from liquid oxygen or liquid nitrogen. The unmodified lines were, however, accompanied by very faint wings, probably to be attributed to rotational changes in unstable helium molecules in the liquid, of a structure recently investigated by Weizel, and formed from a pair of helium atoms each in the normal $1S$ state. This work was done with the low temperature form of the liquid, the form boiling above about 38 mm. pressure being continually full of bubbles which caused large spurious scattering.

Excitation of the Nebular Spectrum.—A short note by H. Nagaoka and T. Futagami (*Proc. Imp. Acad. Japan*, March) contains the announcement of the production in the laboratory of a fresh part of the nebular spectrum. An arc was run between carbon poles in nitrogen or oxygen which had been partly dissociated and ionised previously by causing it to pass through a hole in the carbon. The arc was spread out sideways by a magnetic field, and an auxiliary condensed discharge passed through it, between silver electrodes, at a distance of 15 cm. from the axis of the main poles. The luminosity of the auxiliary discharge extended somewhat towards the carbons, but the more remote parts were free from the bands of carbon monoxide and nitrogen, and showed only silver lines and lines of ionised oxygen and nitrogen. It is stated that the latter included many found in nebulæ and ascribed by Bowen to singly charged oxygen and nitrogen (O II and N II) and to doubly charged nitrogen (N III). The lines coming from doubly charged oxygen (O III) were not observed.

Structure of Tetramminoplatinous Chloride.—Werner's view that the 4-co-ordinated compounds of bivalent platinum possess a planar configuration, the four groups occupying the corners of a square with the platinum at the centre, has been several times contested. Pauling has, however, shown theoretically that the bivalent transitional elements nickel, palladium and platinum can form such compounds with a planar configuration, and, apart from available evidence of a purely chemical nature, his conclusions are supported by investigations on the nickel derivatives of benzylmethyl glyoxime and the X-ray analysis of K_2PdCl_4 and K_2PtCl_4, in which the metal occurs in the anion. Cox (*J. Chem. Soc.*, June) has now shown by X-ray analysis that the same configuration also occurs in the cation, $Pt(NH_3)_4$, of the salt $Pt(NH_3)_4Cl_2$, H_2O, and it appears fairly certain that the bonds to any four identical groups co-ordinated to a platinum atom lie in a plane. The compound in question forms an ionic lattice with one molecule in the unit cell, and the symmetry requires that the ammonia groups are rotating about the covalent bond. The water molecules are loosely held and can be expelled without disrupting the crystal: the best position is probably with the oxygen atom at the centre of the cell. Each platinum atom is surrounded by four ammonia groups in a square and at a greater distance by eight equidistant chlorine ions. Each ammonia group is at the centre of four coplanar chlorine ions, while each chlorine ion is surrounded by eight ammonias.

Astronomical Topics

Comets.—Dr. A. Dubiago gives a definitive orbit for Brooks's periodic comet at its last return, and a predicted one for this year, in *Astr. Nach.* 5874:

T	1925 Nov. 1·729463 U.T.	1932 Oct. 7·5519 U.T.	
ω	195° 39′ 57·33″	195° 48′ 18″	
Ω	177 25 11·60	1925·0	177 27 11	1932·0
i	5 33 11·07	5 32 52	
ϕ	29 8 36·20	29 4 7	
n	513·27574″	511·654″	
log a	0·5597706	0·56075	

An ephemeris from June 5 to Dec. 30 is given; it is very close to that of Mr. F. R. Cripps in the B.A.A. Handbook; Mr. Cripps applied perturbations by Jupiter and Saturn (Dubiago applied those of Jupiter only), and obtained T Oct. 7·623, differing from the other by less than two hours. The conditions this year are very favourable, the comet being in opposition at its perihelion.

The *Journal des Observateurs* for May contains a study by Dr. A. Schaumasse of the periodic comet Borrelly, which has been seen at each return since its discovery in 1905; he has applied perturbations by Venus, Earth, Mars, Jupiter, Saturn, and finds the elements;

T	1925 Oct. 7·53664 U.T.	1932 Aug. 27·79623 U.T.	
ω	352° 25′ 34·11″	352° 33′ 6·74″	
Ω	77 6 12·17	1930·0	77 2 3·63	1930·0
i	30 30 39·83	30 31 47·18	
ϕ	38 3 26·35	38 4 59·78	
n	515·33164″	516·11281″	
Period	6·885251 y.	6·874830 y.	

T in 1932 is 1·8 days later than the value used in the ephemeris in the B.A.A. Handbook. The comet will be well placed as a morning object for northern observers in September and October; a misprint in the Handbook should be corrected. Read 352°, not 325°, for ω.

Slopes of the Lunar Mountains.—Mr. T. L. MacDonald has been contributing a series of papers on lunar statistics to the *B.A.A. Journal*; the issue for May contains a study of the slopes of mountains, which is based on examination of the shadows at different altitudes of the sun. The mean value of the inclination is deduced as being slightly less than 30° for the larger craters, but attaining 36° for those with diameters less than 40 km. Mr. MacDonald states that 30° is the angle at which equilibrium of loose debris is possible. In view of the disturbing effect of the great range of temperature between day and night, the older formations would probably have had time to reach equilibrium; but it is suggested that the small formations may have been the latest, and that there has not yet been time to reach a state of equilibrium. Many of the objects in question are near the borders of the maria, which are likely to be areas of weakness where disturbances may have continued to a later period than in more stable regions.

Mr. MacDonald's work shows that observers need not consider that the moon's surface is so well known that nothing more remains to be done. Visual work can give more continuous records of the changing aspects of the shadows than can be done by photography, in view of the great number of plates that the latter would require.

University Statistics*

THE comparative statistics recently issued by the University Grants Committee for the academic year 1930–31 relate to the twelve universities of England and Wales with their colleges, the independent university colleges of Exeter, Nottingham, and Southampton, the Manchester College of Technology, the four Scottish universities, and the Royal Technical College, Glasgow. The tabular statements, which compress into twenty pages a vast amount of information regarding the finances, students, staffs, and libraries of these institutions, are preceded by an introductory note directing attention to a number of figures of special significance.

Of the 47,587 full-time students included in the returns, 33,569 were in England, 2868 in Wales, and 11,150 in Scotland. Of those in England, nearly a third were at Oxford (4658) and Cambridge (5599), a third at London, and rather more than a third at provincial universities and colleges. One of the tables, entitled "Home and University Residence of Full-time Students", affords a factual basis for criticising certain theories put forward in a recent discussion in the *Universities Review* of the question "What is wrong with the Modern Universities?" It has been suggested that they fall short of what has been expected of them through being too intensely local and through being, in the main, non-residential. The table shows that Bristol and Reading universities and Exeter, Southampton, Aberystwyth, and Bangor university colleges draw more than half of the total number of their full-time students from homes more than thirty miles distant, and can therefore scarcely be described as predominantly 'local'. It shows, too, that Reading, Exeter, and Southampton accommodate more than half their full-time students in colleges or hostels, and may therefore fairly claim to be considered 'residential'. Excluding London, where the proportion of students so accommodated is small, 52 per cent of the full-time women students and 36 per cent of the men were in colleges or hostels.

The same table shows also how many of the full-time students came from homes outside the British Isles but within the British Empire (2759) and how many were from foreign countries (1809). The percentage of foreign students has increased in recent years.

As regards the character of the work in which university students were engaged, they are graded in Table 3 as 'advanced' (including research workers), 'first degree', and 'diploma'. Full-time students were distributed among these grades as follows: 2237; 36,886; 8464. The table includes also particulars of 14,725 part-time students, of whom 8280 were not classifiable under the above grades, as the courses they followed did not lead to degrees or diplomas: more than half of these were in London (chiefly University and King's Colleges and the London School of Economics) and Glasgow (Royal Technical College). A further indication of the standard of work is afforded by the number of higher degrees (excluding those granted without examination), namely, 1323, and higher diplomas, 346.

Fields of study are demarcated in five compartments: arts (including theology, fine art, law, music, commerce, economics, and education), pure science and mathematics, medicine (including dentistry), technology (including engineering, applied chemistry, mining, metallurgy, architecture, etc.), and agriculture. The distribution of the general body of full-time students was: arts 51·8 per cent, medicine 20·8, pure science 16·5, technology 9, agriculture 1·9; but taking advanced students alone, the pure science group is the largest (42·6 per cent), followed by arts (38·4), medicine (7·6), technology (9·7), and agriculture (1·7). The following table gives the names of the universities in which the pure and applied science groups (excluding medicine) were most numerous:

Pure Science.		Technology.		Agriculture.	
Cambridge	1168	London:		Reading	190
Oxford	569	Imp. Coll.	602	Cambridge	157
Manchester	530	Univ. Coll.	265	Edinburgh	133
London:		Cambridge	568	Oxford	99
Univ. Coll.	518	Liverpool	326	Aberdeen	74
Imp. Coll.	376	Glasgow	304	Aberystwyth	58
Glasgow	429	Manchester:			
Liverpool	295	Coll. of Tech.	272		

Of the advanced work in pure science, four-fifths was in chemistry and physics.

The financial statements show incomes amounting in the aggregate to nearly six million pounds, as follows:

London	£1,607,149
Oxford and Cambridge	1,053,477
English Provincial Universities and Colleges	1,960,153
Wales	346,768
Scotland	863,389

These figures include the addition to the Treasury grant voted by Parliament in 1930 for the quinquennium beginning 1930–31, and show therefore a considerable advance upon the figures for the previous year. Parliamentary grants, together with grants from local authorities, now constitute on an average 45 per cent of income in England, 67 per cent in Wales, and 43 per cent in Scotland. Thanks to the addition to the grant, only ten of the fifty-two institutions ended the year with deficits, and the aggregate amount of these was but £11,403.

Expenditure on libraries, which is exhibited in some detail in a special table, amounted to four per cent of the total expenditure, and more than ten per cent of it was for purchase of learned journals. Commenting on this, the committee observes that "the most serious and perplexing problems which at present exercise the minds of librarians all the world over are those which arise out of the increasing number and cost of periodicals".

* University Grants Committee: Returns from Universities and University Colleges in receipt of Treasury Grant, 1930–31. Pp. 28. (London: H.M. Stationery Office, 1932.) 1*s.* 6*d.* net.

Condensed and Dried Milk*

DR. L. A. ALLEN, of the recently founded Hannah Dairy Research Institute, has brought together and reviewed, in the publication before us, the facts relating to the preparation of condensed and dried milk products. The pamphlet appears at an opportune time, since for reasons of national economy efforts are now being made in Great Britain to increase supplies of home-produced foods. Large amounts of condensed and dried milk are imported annually into the country, the totals for 1931 being given as 2,700,000 cwt. and 250,000 cwt. respectively.

Just as in the case of the commercial canning of

* The Hannah Dairy Research Institute. Bulletin No. 3: The Properties of Milk in relation to the Condensing and Drying of Whole Milk, Separated Milk, and Whey; a Review of existing Knowledge. By Dr. L. A. Allen. Pp. 159. (Auchincruive: Hannah Dairy Research Institute, 1932.) 4*s.* 6*d.* net.

fruit and vegetables, where at the present time, by improvements in technical methods and the organisation of suitable supplies, an important industry is developing, so in the condensation of milk—whether to furnish evaporated (unsweetened) milk, sweetened condensed milk, or dried milk—development ought not to be difficult. The first requisite for such development is a knowledge of the raw material, and in Part 1 of the bulletin an account is given of the influence of the various components of milk in condensing and drying. Part 2 deals with the colloidal properties of milk, as these are important with reference to coagulation by heat in the manufacturing processes, and in the alcohol test, by which the suitability of milk for condensing is judged. The influence of heat on milk, both as regards the bacterial flora and changes of a chemical nature, are discussed in Part 3, and the effect in both cases is shown to have important bearings upon factory methods and upon the final product.

The manufacture of sweetened condensed milk is, as would be expected, described fully, the technical operations first being outlined. Sections on the bacteriology of the product, the control and testing of the raw milk, the bacterial flora of milk, all give a good résumé of the present state of knowledge. In the last section of Part 4 are described the defects in condensed milk, due on one hand to micro-organisms and on the other to chemical or physical changes.

In Part 5 evaporated milk is dealt with in a similar manner, and in Part 6 dried milk; in the latter Part the composition and properties of milk powders are discussed especially with reference to keeping qualities.

The waste of valuable food material in the whey from cheese factories—the loss has been estimated to be about £1,000,000 annually in Great Britain—has occasioned much thought, and a certain amount of research work has been undertaken, but so far no commercially successful method of utilising the whey has been put into operation. What has been achieved is recorded in Part 7, and it seems very probable that with the knowledge now available and the perfecting of the engineering details a food capable of being used in the confectionery and sweet trades will be manufactured economically.

The final part of the bulletin discusses the uses of condensed milk and dried milk in the household and in industry.

The writer of the bulletin—Dr. L. A. Allen—is to be congratulated upon the thoroughness with which he has gathered together the material, and upon the skilled and critical manner in which he reviews it. In each section the points having a bearing upon the subject under discussion are clearly brought forward.

Altruism in Science and Industry

UNDER the title "Science and Industrial Sanity", in the *Hibbert Journal* for July 1932, Mr. H. P. Vowles and his late wife, Margaret Vowles, discuss some of the effects of the application of science to industry during the last century and half, particularly the enormous increase in productivity and the unaccompanying unemployment. They reject at the outset the pleas for a return to the pre-scientific age or for the suspension of scientific research and its application to industry for several decades, and point out that the spectacular increase in productive capacity has been accompanied by a considerable change in the ethical standards of industry. Wherever science has influenced industrial activity, the spirit of service has come into competition with the desire for private gain. The serious problems with which mankind is now confronted are mainly attributed to the existence of whole tracts of industry, notably those concerned with the monetary aspects of distribution, which are uninfluenced by science, and where alike the scientific method and the spirit of service have yet to penetrate.

In support of their contention, the authors refer to the noble tradition of science that the service of mankind should be given precedence over personal advancement, and to the part played by the engineer in the permeation of industrial activities with the ideal of public service. Engineering institutions and societies have all adopted the attitude that though engineers must normally earn a living by their work, the primary purpose of engineering activity is the service of mankind. Political economy similarly became imbued with the idea that co-operation is a nobler ideal than self-interest, and to-day the idealism of the engineering societies is only one of the indications that as industry becomes more influenced by science the obligation upon all to subordinate self-seeking to the common good becomes more widely acknowledged.

Accordingly, with this change in mind, it is possible to view without dismay the enormous increase in the power resources affecting not only manual but also clerical labour, or the realisation that the mechanical invasion of mankind is only in its initial stages. The penetration of science to the world's monetary and distributive systems is bound to follow; and beyond this, the complete permeation of industry by science, involving the attainment of higher educational levels for all and producing a saner work-day environment, should be of considerable assistance in guiding men to sane uses of the leisure which will be available for all in the completely scientific State. Such rationalisation and reorganisation necessarily involve a very wide margin of leisure for all, but if science enables men to see industry in its right perspective and themselves in their right relation to industry and to one another, the fear that leisure will be used unwisely in the scientific State may never be justified in the event. Nor need we dismiss as utopian the suggestion that science and machinery, and the leisure they make possible, are destined to play an indispensable part in lifting men to new and higher levels of endeavour and achievement.

Development of the 'Grid' in Great Britain

AN address by Sir Archibald Page, chief engineer of the Central Electricity Board, on the 'grid' for electric supply in Great Britain was given recently to the Electrical Association for Women (the *Electrical Age*, July). Sir Archibald points out that there are three main stages of getting electricity to the consumers' terminals, namely, generation, transmission, and distribution. The Central Electricity Board is primarily concerned with the first and in a less degree with the second of these stages.

At the beginning of this century, engineers recognised that electricity can be produced much more cheaply in large quantities, and that electricity is the most convenient agency for the transmission of power, heat, and light. Companies possessing several stations found it advantageous to link them together. The outbreak of the War and the subsequent increased demand for power led to the appointment of the Electricity Commission to regulate and promote the production and distribution of electricity in accordance with modern ideas.

In 1925 the Weir Committee recommended the

establishment of a system of main transmission lines called the 'Grid Iron' for the purpose of interconnecting the principal generating stations of Great Britain, and in due course proposed the shutting down of less efficient stations. To effect this, a new organisation called the Central Electricity Board was set up to manage what may be called the 'wholesale' side of the supply industry. This Board is now hard at work accelerating the completion of the 4000 miles of transmission line and the numerous transforming and switching stations involved, and is already well ahead of its original programme.

Although on technical and financial grounds it was advisable to use overhead lines, it was necessary to use a considerable mileage of cable, mainly in the London district. The value of the orders given by the Board to British firms now exceeds 22 million pounds. This has reacted on unemployment figures and the electrical industry is one of the few flourishing industries in the country. The Board is in no sense a government department. It is part of the supply industry and is financially self-supporting.

Great Britain with its dense population, diversified industries, cheap coal, and extensive coast-line is an ideal country to electrify. What is needed is an efficient organisation to ensure that expansion of output which will bring cheap electricity to the consumer. The field is wide. Only about 65 per cent of the machinery utilised in industry is electrically driven. There are eleven million potential consumers in Great Britain and only about four and a quarter million are connected with the supply mains.

Sir Archibald Page pointed out that Great Britain was the first country to lay down a national system of electric trunk mains. It was now almost impossible to make a train or car journey of any distance without seeing some of the lattice steel towers supporting the electrical conductors which constitute the 'grid'.

University and Educational Intelligence

CAMBRIDGE.—At Emmanuel College the studentship offered for competition to graduates of other universities intending to commence residence as research students in October has been awarded to L. Belchetz, Rhodes University College, Grahamstown, South Africa (chemistry). The studentship held by J. W. Harding (Victoria University College, Wellington, New Zealand) for mathematical physics has been renewed for a third year. Internal studentships offered for competition to members of the college have been awarded as follows: B. V. Bowden (physics) for one year, A. J. Ward (mathematics) for two years.

LONDON.—The following degrees have been conferred: D.Sc. in biochemistry on Manayath Damodaran (Imperial College—Royal College of Science) for a thesis on "The Amino-Acids of Gluterin" (*Biochem. J.*, 1931), "The Dicarboxylic Acid Nitrogen of Proteins" (*Biochem. J.*, 1931), and "The Isolation of Asparagine from an Enzyme Digest of Edestin" (*Biochem. J.*, 1932). D.Sc. in chemistry on Ranchhodji Dajibhai Desai (Imperial College—Royal College of Science) for a thesis entitled "The Influence of Methylcyclopentane and Methylcyclohexane Rings on Carbon Tetrahedral Angle" (*J. Chem. Soc.*, May 1931 and April 1932). D.Sc. in mining geology on Mr. G. C. A. Jackson (Imperial College—Royal School of Mines) for a thesis entitled "The Geology and Ore-deposits of the N'Changa Mine and District, Northern Rhodesia", a portion of which, entitled "The Ores of the N'Changa Mine and Extensions, Northern Rhodesia", has been published in *Economic Geology*, vol. 27, No. 3, 1932. D.Sc. in psychology on Mr. S. J. F. Philpott (University College) for a thesis entitled "Fluctuations in Human Output" (*Brit. J. Psych.*, 1932).

IT is announced that the Prudential Assurance Company has offered to contribute £1500 a year for a term of seven years to the London School of Hygiene and Tropical Medicine. The suggestion that the contribution shall be directly associated for the duration of the gift with the University chair of public health has been accepted by the governors of the School.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Overseas Scholarships for 1932:—On the recommendation of McGill University: Mr. J. F. Heard (physics, Imperial College of Science and Technology, London), Mr. M. K. McPhail (biochemistry, National Institute for Medical Research, London); on the recommendation of Queen's University, Kingston: Mr. W. J. Henderson (physics, University of Cambridge), Mr. G. S. Farnham (metallurgy, University of Manchester); on the recommendation of the University of Melbourne: Mr. A. B. Edwards (geology, Imperial College of Science and Technology, London); on the recommendation of the University of Sydney: Thelma M. Reynolds (organic chemistry, University of Oxford); on the recommendation of the Universities of Cape Town and the Witwatersrand: Dr. E. C. Halliday (physics, University of Cambridge and the Experimental Station of the Radio Research Board, Slough); on the recommendation of the University of New Zealand: Mr. R. M. Barrer (physical chemistry, University of Cambridge).

Calendar of Geographical Exploration

Aug. 10, 1537.—De Vaca and the Gulf of Mexico

In 1528, Cabez de Vaca had accompanied Pamfilo de Navarez on an expedition which landed on the west coast of Florida near Tampa Bay. In a subsequent march they lost touch with their ships and the party broke up. In the winter of 1528–29, of a party of 80 on the 'Island of Misfortune' off the coast of Texas, only 15 survived. De Vaca was one; he crossed to the mainland and spent five years among the natives. Then, with a companion, he travelled south, crossing the Brazos and Colorado Rivers and reaching San Antonio Bay. Ultimately he reached Mexico City and returned to Europe, arriving at Lisbon on Aug. 10, 1537. His account of the riches of the region which he had visited resulted in the journeys of Coronado and de Soto.

Aug. 11, 1901.—Kaiser Wilhelm II. Land

Prof. von Drygalski left Kiel on Aug. 11 in the *Gauss*, reaching Kerguelen Island on Dec. 31, where a party of German scientific workers had landed a few months earlier and had set up an observatory. The *Gauss* wintered in the ice, and a sledging party discovered the land named Kaiser Wilhelm II. Land, with a hill 1500 ft. high, which was named the Gaussberg. The expedition not only discovered new land, but also recorded many valuable scientific observations.

Aug. 12, 1767.—Carteret's Discoveries in the Pacific

Capt. Carteret in the *Swallow*, after discovering Pitcairn Island, reached the Santa Cruz group. Although these islands had been discovered by Mendaña a century before, their position was but imperfectly known and Carteret may be credited with their rediscovery. Later the group now known as the Carteret

Islands was discovered, though Carteret himself identified them wrongly. Carteret's most important discovery was that the strait between New Britain and New Ireland was a channel and not a bay, as Dampier had concluded. Other small islands were discovered and the south coast of Mindanao was examined, the *Swallow* returning home in 1769.

Aug. 13, 1829.—The North Magnetic Pole

Sir John Ross in the *Victory*, accompanied by his nephew, James Clark Ross, in a ship fitted up by Sir Felix Booth, reached Fury Beach, where Parry had abandoned the *Fury* in 1825. Their object was to find the north-west passage. In this they failed, but the land called Boothia in honour of Sir Felix Booth was discovered, and James Clark Ross, by means of sledge journeys, located the north magnetic pole in 70° 5′ 17″ N., 95° 46′ 53″ W., on the western coast of Boothia. He also discovered and named King William Land and surveyed its northern shore. Their boat was frozen in during its first winter and the Rosses were unable to extricate it. They thus spent four winters in the region, when fortunately they were picked up by a whaling vessel in Lancaster Sound, which they had reached by boat. This whaler, the *Isabella*, was the same ship in which J. C. Ross made his first voyage to the arctic regions in 1818. J. C. Ross in 1839–43 did magnificent work in the antarctic. (See Calendar for Jan. 1.)

Societies and Academies.

DUBLIN

Royal Dublin Society, May 24.—Irish Radium Committee Report for the year 1931. 16,756 millicuries of radon were issued during the year for therapeutic purposes. Detailed reports from some of the largest users record the results of the treatment of 400 cases.—J. Stuart Thomson: The anatomy of the tortoise. A study of the morphology of the closely allied species, *Testudo ibera* and *T. græca*, system by system, in a way never attempted in a chelonian since the classic work of Bojanus on *Emys europæ* in 1819. The dissections of the vascular system from injected specimens, showing the complicated connexions of the arteries and veins related to the carapace, are some of the important features. Transverse sections of a six-weeks-old *Testudo* cut in celloidin are figured. The author recommends the importance of some dissections from the dorsal surface, after dissolving away the carapace with acid.—W. E. Abraham: Contact angles in an oil-water interface and their application to free flotation in the Weva inclinometer. In this instrument a floating magnet is used to determine the magnetic meridian. The magnet is encased in ebonite coated with gutta-percha, which lies in an oil-water surface in a containing glass vessel. As the water does not wet the gutta-percha, capillary repulsion ensures free rotation.—J. Lyons and G. T. Pyne: Factors affecting the body or viscosity of cream and relative matters. Data are presented to show the effect of separation temperature, previous chilling, and pasteurisation of milk, and re-separation of chilled pasteurised cream on the viscosity of the ultimate product.

EDINBURGH

Royal Society, June 20.—Pierre Rijlant: Automatism and conduction in the mammalian heart. The contraction of the heart starts in the sinus region. This initial activity is accompanied by mechanical and electrical changes limited to the sinus. The cathode ray oscillographic records of the pacemaker's activity show a series of electric waves, each of them being localised to a limited region of the sinus. The initial wave appears in a limited spot situated at the venous side of the sinus and corresponding to the embryological remnant of the right duct of Cuvier. The transmission of this initial activity to the auricle occurs through a differentiated contractile conduction system. In the mammalian heart automatism and rhythmicity occur in a limited region with characteristic structure. These regions are contractile and their contraction is independent from that of the myocardium. Transmission occurs through a differentiated system which unites the different segments of the myocardium.—L. Hogben: Filial and fraternal correlations in sex-linked inheritance. When inheritance is sex-linked, the correlations of relatives differ from those based on the more typical mode of transmission, and differ according to the sex of the pairs. As compared with filial correlations of the Pearsonian type, the correlation for father and son is zero, for mother-daughter it remains unchanged, and for father-daughter or mother-son it is raised. The correlation for brother-sister is lowered as compared with Pearson's fraternal coefficient. For brother-brother it remains unchanged and for sister-sister it is raised. From the formulæ given it is seen that no comparison between twin correlation is valid unless the sex composition of the groups compared is identical. In addition, it is seen that a study of correlation between relatives classified in every possible way with respect to sex could provide a means of estimating the contribution of sex-linked genes to the observed variants in a population.—A. Graham: On the structure and function of the alimentary canal of the limpet. In *Patella vulgata* the radula, lubricated by the salivary secretion, scrapes the food particles, mainly diatoms and small algæ, off the rocks on which the animal is living, and conveys them to a ciliated food channel running down the fore-gut. Into this channel ciliary currents convey an amylolytic enzyme secreted by side folds in the same region. The mixture of food and enzyme is absorbed by absorbing cells in the digestive gland. The rest of the alimentary canal, of which five histologically different portions may be distinguished, is chiefly concerned with elaborating the waste matter into rod-shaped fæcal masses.—S. M. K. Henderson: Notes on Lower Old Red Sandstone plants from Callander, Perthshire. South of Callander, plant-bearing flagstones occupy the centre of a great syncline, and are exposed in the area between the Rivers Teith and Forth. The following have been obtained from an exposure in the Tarr Burn at Ballanucater Farm: (1) *Pachytheca* sp.; (2) *Arthrostigma gracile*, Dawson; (3) *Psilophyton*, Dawson, and associated remains that may belong to the one plant. Those included under (3) may be grouped into (*a*) spiny stems, (*b*) slender spineless dichotomous branch-systems, (*c*) stout and slender branch-systems with axillary structures. The consideration of these remains has raised two questions: Does the association of plants of type (*b*) with those of type (*a*) indicate the appearance of *Hostimella*-like plants in the Lower Old Red Sandstone, or may they be classed under some such form as *Psilophyton goldschmidti*? The second question concerns the demonstration of axillary structures in some of the branch-systems (*c*). Do they belong to spiny axes of *Psilophyton* type, or do they indicate the presence of another type that would have to be classed as *Hostimella* sp.?

PARIS

Academy of Sciences, June 20 (vol. 194, pp. 2181-2248).—H. Douville: Notice on the work of Albert de Grossouvre.—C. Matignon and M. Léon: The thermo-

chemistry of the calcium orthophosphates. — **Louis Blaringhem**: The inheritance of sex in meadow sage (*Salvia pratensis*). Although the author has been unable to establish a line of *S. pratensis* containing only female descendants, it is probable that in six generations the percentage of individuals of this sex could be raised to 90 per cent.—Jean Tilho was elected a member of the Section of Geography and Navigation in succession to the late General Ferrié. Jean Cabannes was elected *correspondant* for the Section of Physics. — **Jean Bosler**: The apparent rarity of hyperbolic comets.—**A. Buhl**: Multipoint movements corresponding to the Schrödinger equation written for the case of a single point.—**C. Courty** and **C. Chéneveau**: The direct measurement of the magnetic susceptibilities of liquids, by the Curie-Chéneveau magnetic balance. Data are given for carbon tetrachloride, chloroform, alcohol, and pyridine.—**T. N. Panay**: The realisation of a black body at the boiling point of metals. A method of obtaining black body radiators at fixed temperatures. Details are given of the construction of a black body radiator working at the boiling point of zinc.—**J. Gilles**: The variation in the wave-length of lines emitted by a copper arc of great intensity. The stability of the arc was ensured by using a brass anode and graphite cathode. Three wave-lengths were studied, 5218, 5153, and 5105. The last showed no change, but the first two showed displacements of the same order.—**F. Wolfers**: The possibility of a Compton effect in optics. From a mathematical study, the trajectories of the photons are reflected and refracted at the surface of separation of two media in such a manner that the frequency of the photons remains invariable. Hence in interference phenomena there is no difficulty due to the Compton effect.—**Marcel Cau**: The interpretation of the experiments of Pogány; the influence of the thickness.—**S. V. Sze**: The magnetic spectrum of the β-rays emitted by ThC + C′ + C″. Details of measurements of 28 lines, half of which are new.—**Mme. Irène Curie, F. Joliot, and P. Savel**: Some experiments on the radiations excited by the α-rays in light bodies. Experiments on the action of the α-rays on lithium and beryllium.—**Francis Perrin**: The possible emission of demi-helions during certain induced radio-activities. The possibility of the existence of a demi-helion, resulting from the reunion of a proton and a neutron (mass 2, charge 1) is discussed, and some consequences deduced.—**Pierre Dubois**: The reduction of permanganate by manganese sulphate. Study of the variations in oxygen content of the precipitate produced by changing the amount of permanganate and the *p*H of the liquid.—**M. Battegay** and **L. Denivelle**: Aminosulphonamide or sulphamide, $SO_2(NH_2)_2$.—**P. Carré** and **D. Libermann**: Thionylaniline as a reagent in organic chemistry. Its use for the characterisation of acids as anilides. Thionylaniline may serve to identify many acids as anilides. Cases are described for which the method is unsuitable.—**Mailhe** and **Creusot**: The thermal decomposition of isopentane in the presence of silica gel. At 680° C., with silica gel as catalyst, for 15 seconds heating, isopentane gives 75 per cent gaseous products and 25 per cent liquid rich in ethylenic and aromatic hydrocarbons. — **Paul Gaubert**: Tints due to the pleochroism of crystals and of artificially coloured spherolites.—**N. Stoyko**: The periodic displacements of continents. A discussion of the periodic variations of longitudes of various observatories. The period of the variation is about eleven years, the same period as the sunspot variation. —**Ernest Esclangon**: Remarks on the preceding communication.—**G. A. Nadson** and **C. A. Stern**: The action at a distance of metals on micro-organisms. A continuation of previous work on the same subject. The action of the metal is stronger (that is, the colonies developed are fewer) as the atomic number of the metal increases. The possible cause of this action is discussed; it is not due to the production of ozone or of hydrogen peroxide.—**J. M. Lys**: The composition and evolution of the reserves in *Cyclamen latifolium*. —**E. Sollaud**: The development of *Palœmonetes mesopotamicus* compared with that of other *circa*-Mediterranean *Palœmonetes*.—**Emile Terroine, Mlles. Marguerite Champagne** and **Gilberte Mourot**: The distribution of the urinary type of nitrogenous metabolism in various species of mammals during the minimum of specific endogenous discharge.—**Jules Amar**: Conclusions on hydrothermal metabolism.— **A. M. Monnier** and **H. H. Jasper**: The action of the centres on the various characteristics of the nerve fibre. The analogy with electrotonus.—**J. Lignières**: The causes of the attenuation and exaltation of the aphthous virus. Recurrence in aphthous fever. The choice of virus for antiaphthous vaccination.

MELBOURNE

Royal Society of Victoria, April 14.—**G. F. Hill**: Australian *Rhinotermes* (Isoptera). The first two species described, *Rhinotermes intermedius* Brauer and *R. reticulatus* Froggatt, are regarded as being specifically distinct, whilst the remaining hitherto described species, *R. breinli* Hill, is proposed as a subspecies of the former. Three new subspecies are described, namely: *R. intermedius seclusus*, *R.i. actuosus*, and *R.i. derosus*, as in the soldier caste (two forms) of Brauer's species. Comparative measurements of species and subspecies of *Rhinotermes* are given.—**R. B. Withers**: A new genus of fossil king-crabs. The author described a new genus and species of fossil king crabs, *Rutroclypeus junori*, from the Silurian, Kinglake West, Victoria. The relatively large dorsal shield and long tail spine are adaptations to the animal's burrowing habits.—**C. W. Brazenor**: A new record of a beaked whale (*Mesoplodon*) from Victoria. This is the first discovery of *Mesoplodon grayi* Haast on the Victorian coast. The upper half of a skull and two caudal vertebræ were found at Cape Schanck, near Flinders.

ROME

Royal National Academy of the Lincei, Feb. 21.— **U. Cisotti**: Motion with 'wake' of a flexible profile; dynamic actions (2).—**G. Abetti**: Altitude of the chromosphere in 1931. For the mean height of the chromosphere during 1931, observations at Arcetri on 118 days give the value 9·84″, whereas those at Madrid on 29 days give 10·14″. The former indicate diminution of 0·44″ in comparison with 1930, and the latter an increase of 0·33″, the latter result being probably due to the small number of observations made. As was previously noted, the value is highest at the poles and lowest at the equator. The observations at Arcetri, Catania, Madrid, and Zurich show that the total area of the prominences, measured in units of prominence, diminished by 68 from that of 1930, whilst for the preceding year the decrease was 291. In 1931 the maximum frequency of the prominences is shown in both hemispheres at latitude 45°, this being regarded as an indication of the commencement of a new cycle.—**E. Paternò**: (1) Cryoscopy and molecular weight of polymerides of carbohydrates. Cryoscopic determinations of the molecular weights of derivatives of cellulose and analogous products are regarded as valueless.—(2) Cellulose in Schweitzer's reagent. The preparation of a solution of cellulose in Schweitzer's reagent, without previous preparation of this reagent, is described. In this way a solution is obtained which is much richer in cellulose than those made in the ordinary way.—(3) Cellodextrin, amyloids, and pentosans.—**L. Cambi, L. Szegö**, and **A. Cagnasso**:

Magnetic behaviour of complex compounds. (4) Ferric *N*:*N*-dipropyl dithocarbamates. The results now given refer to the di-*n*-propyl, *n*-propyl-isopropyl, and di-isopropyl compounds.—**G. Andreoli**: Reciprocal pairs of V_2: laws of duality of the linear and tangential metrics, of parallelism, and of metrism. (1) Variational problems.—**Patrick Du Val**: Surfaces of one kind which are not bases for a system of quadrics.—**Luisa Pelosi**: Levi-Civita's parallelism.—**C. Antoniani** and **F. Zanelli**: Investigations in the phytosterol group: Sterols of grape-seed oil. When the crude sterol product of grape-seed oil is subjected to acetylation and bromination according to Windaus's method, a single soluble bromo-acetyl derivative is obtained. The presence of stigmasterol and analogous sterols is thus excluded.—**A. Corbellini** and **C. Pizzi**: Stereoisomerism of 2 : 2′-disubstituted derivatives of diphenyl. The resolution of 2-[bisphenylmethoxy]-2′-diphenylcarboxylic acid into its optical antipodes is described.—**Z. Jolles**: Diazo-resins (1). Diazo-resins obtained, usually together with the corresponding aromatic hydrocarbons, from the normal diazohydrates of aniline, *m*- and *p*-toluidines, *o*- and *p*-anisidines, *o*- and *p*-phenetidines, *o*- and *p*-aminobenzoic acids, and α-naphthylamine in presence of sodium hydroxide, are described. The nitrogen contents of the products are mostly in good agreement with those calculated from the equation (for aniline), $4C_6H_5.N_2OH = C_{24}H_{18}ON_2 + H_2O + 3N_2$. The resinification seems to result from internal oxidation of the diazo-compounds.—**A. Rossi**: Crystalline structure of praseodymium. X-ray examination by the powder method of a specimen of praseodymium (of 99·4 per cent purity) gives the value 1·62 for the axial ratio $c : a$ and 3·657 A. for the side of the unit cell. The calculated density is 6·777, the experimental value being 6·765±0·008. Good agreement is shown between the calculated and observed intensities of the spectral lines.—**F. V. Madon** and **S. Goldberger**: The adrenaline blood-sugar curve during fatigue and the potassium-calcium ratio. The experiments described were made on four individuals. Fatigue is accompanied by a marked increase (15-20 per cent) in the potassium content of the blood, the calcium content remaining constant. The influence of fatigue on the action of adrenaline on blood-pressure shows irregular and individual variations. The blood-sugar is, however, always markedly lower after labour than during rest.—**A. Baroni**: Existence of polythionic chlorides: determination of the refractive indices of solutions of sulphur in sulphur chlorides. Measurements have been made of the refractive indices of mixtures of sulphur with sulphur chlorides (SCl_2 and S_2Cl_2) heated to 100°, 150°, or 200°, and of the same mixtures after these have aged for about six months. The results render probable the existence of a polythionic chloride S_3Cl_2, and seem to exclude the existence, within this range of temperature, of compounds richer in sulphur.—**G. Piccardi** and **A. Sberna**: Molecular spectra and spectroscopic analysis. (3) Investigations on yttrium. Yttrium monoxide, YO, obtained by volatilising any yttrium compound, exists as such in the oxy-hydrogen flame, and yields a spectrum composed solely of bands of the monoxide and free from atomic lines. The orange and red regions show two systems of irresolvable narrow bands with origins at λ5972 and 6132, and a vast system of wide bands with origin at about λ4817, these being resolvable into lines by a powerful apparatus.—**G. Checchia-Rispoli**: *Sanfilippaster*, a new genus of echinoids of the upper cretaceous.—**Zippora Danin**: Gaseous content of the cenobia of *Rivularia polyotis* (J. Ag.) Hauck. The gases secreted in these cavities are similar to those formed in the corresponding cavities of brown and green algæ.

Official Publications Received

BRITISH

Journal of the Indian Institute of Science. Vol. 15A, Part 2: Chemical Examination of the Root-Bark of *Plumbago rosea*, Linn. By M. C. Tummin Katti and V. N. Patwardhan. Pp. 9-16. 8 annas. Vol. 15A, Part 3: Dilatometric Studies in Enzyme Action. Part 2: Contraction Constants of Enzyme-Substrate Reactions. By M. Sreenivasaya and H. B. Sreerangachar. Pp. 17-24. 12 annas. Vol. 15A, Part 4: Aryl Di- and Poly- Stibinic Acids; Distibinous Oxides and Distibino-Compounds. By Sohrab M. Mistry and Praphulla Chandra Guha. Pp. 25-40. 1 rupee. Vol. 15B, Part 2: Measurement of Power Factor and Loss in Dielectrics. By T. J. Mirchandani, G. Yoganandam, S. K. Roy and N. V. Narayanaswami. Pp. 17-32. 1.4 rupees. (Bangalore.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 5, June. Pp. 219-270+xxxii. (London.)

Journal of the Chemical Society. June. Pp. v+1641-1964+viii. (London: Chemical Society.)

British Standards Institution. No. 458: British Standard Specification for Xyloles (Pure Xylole, 3° Xylole and 5° Xylole). Pp. 29. (London: British Standards Institution.) 2*s*. net.

School Buildings. By John Sargent and A. H. Seymour. Pp. 30. (London: National Union of Teachers.)

Proceedings of the Physical Society. Vol. 44, Part 4, No. 244, July 1. Pp. iv+439-528. (London: Physical Society.) 7*s*. net.

Quarterly Journal of the Royal Meteorological Society. Vol. 58, No. 245, July. Pp. 217-320. 7*s*. 6*d*. No. 246: Report on the Phenological Observations in the British Isles from December 1930 to November 1931. By J. Edmund Clark, Ivan D. Margary, Richard Marshall and C. J. P. Cave. (No. 41.) Pp. 321-376. 3*s*. (London: Edward Stanford, Ltd.)

British Empire Cancer Campaign. Ninth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 11.7.32. Pp. 209. (London.)

Proceedings of the Royal Society of Edinburgh, Session 1931-32. Vol. 52, Part 3, No. 14: The Fæcal Pellets of the Anomura. By Hilary B. Moore. Pp. 296-308+2 plates. 1*s*. 6*d*. Vol. 52, Part 3, No. 15: A Study of the Tyrosinase of Potato Tubers. By Dr. Ian M. Robertson. Pp. 309-314. 9*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Canada: Department of Mines: Geological Survey. Summary Report, 1931, Part C. (No. 2308.) Pp. ii+C93. Economic Geology Series, No. 10: Gold Occurrences of Canada; Summary Account. By H. C. Cooke and W. A. Johnston. (No. 2309.) Pp. iii+61. 20 cents. (Ottawa: F. A. Acland.)

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 14, Part 4. Pp. 251-430. (Pretoria.)

Proceedings of the Sugar Cane Investigation Committee. Vol. 4, Part 1, June. Pp. 61. (Trinidad: Imperial College of Tropical Agriculture.)

The Freshwater Biological Association of the British Empire. Report of the Council, 1932. Pp. 7. (Cambridge: J. T. Saunders, Hon. Sec., Christ's College.)

Harper Adams Agricultural College, Newport, Shropshire. Pig Feeding Report No. 1; The Work of the Harper Adams College Pig Feeding Experimental Station, 1926–31. Pp. 44. (Newport.) 1*s*.

FOREIGN

Beiträge zur Natur- und Kulturgeschichte Lithauens und angrenzenden Gebiete. Herausgegeben von Prof. Dr. E. Stechow. Vegetationsstudien auf lithauischen und ostpreussischen Hochmooren. Von Dr. H. Reimers und Dr. K. Huech. Pp. 409-494+12 Tafeln. Biologische und morphologische Notizen über den Kaukasuswisent. Von E. W. Pflizenmayer. Pp. 497-504+3 Tafeln. Über die einstige Hege des Wisent im Urwalde von Bialowies; Über einige Muriden aus Lithauen. Von Prof. Dr. E. Stechow. Pp. 505-510+1 Tafel. Archäologische Untersuchungen im Urwalde von Bialowies. Von Prof. Dr. A. Götze. Pp. 511-550+10 Tafeln. Über Wachstums- und Altersveränderungen am Skelett des Wisents. Von Dr. Walter Koch. Pp. 553-678+3 Tafeln. Vorwort und Inhaltsverzeichnis. Pp. viii+1 Tafel. (München: Bayerische Akademie der Wissenschaft.)

Proceedings of the United States National Museum. Vol. 80, Art. 22: New West Indian Cerambycid Beetles. By W. S. Fisher. (No. 2922.) Pp. 93. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 141: Some Chewing Insects infesting Michigan Evergreens. By E. I. McDaniel. Pp. 54. Circular Bulletin No. 143: The Construction and Management of Air-Cooled Storages with Special Reference to Apples. By Roy E. Marshall. Pp. 43. Special Bulletin No. 221: Controlling the Codling Moth in Southwestern Michigan. By Franklin Sherman III. Pp. 31. Special Bulletin No. 223: Bald Rock Wheat. By E. E. Down and H. M. Brown. Pp. 19. Technical Bulletin No. 122: The Dissociation of *Salmonella pullorum* and related Species. By W. L. Mallman. Pp. 40. Technical Bulletin No. 123: The Diagnosis of *Brucella* Infection in Animals and Man by Rapid Macroscopic Agglutination. By I. F. Huddleson. Pp. 18. (East Lansing, Mich.)

Cornell University Agricultural Experiment Station. Bulletin 533: A Statistical Analysis of the Results of Breeding High-Line and Low-Line Leghorns. By D. R. Marble and G. O. Hall. Pp. 38. Bulletin 537: The Chemical Composition of the Muck Soils of New York. By B. D. Wilson and E. V. Slaker. Pp. 25. Bulletin 538: Soil and Field-Crop Management for Cayuga County, New York, by A. F. Gustafson: Pastures, their Improvement and Management, by D. B. Johnstone-Wallace. Pp. 114. (Ithaca, N.Y.)

CATALOGUES

Important and Rare Books on Gardening and Agriculture (1801 to Recent Times), including Forestry, Fruit-Culture, Medical Botany, Tobacco, etc. (New Series, No. 29.) Pp. 164. (London: Wheldon and Wesley, Ltd.)

Diathermy Apparatus (Surgery and Treatment). (Publication No. P. 32.) Pp. 24. (London: Newton and Wright, Ltd.)