NATURE

SATURDAY, OCTOBER 20, 1934

No. 3390 Vol. 134

CONTENTS

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number: WHITEHALL 8831
Telegraphic Address: PHUSIS, LESQUARE, LONDON

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4
Telephone Number: City 4211

The Native Problem and Research in Africa

THE work which has been carried out by Dr. H. L. Gordon, of Nairobi, on the mental capacity of the natives of Kenya, has attracted widespread attention in medical and scientific circles both in Africa and in Great Britain. As a result of his observations, he maintains that the brain of the African attains its maximum development at about the age of eighteen years, and that after that period there is a gradual decrease. Further, he finds that the average mental age of a group of educated Africans is equal to that of the European child at 10·5 years, and that senility might be expected at any age after thirty-five years; while in 2,000 post-mortems conducted by his colleague, Dr. Vint, not one subject had attained the age of sixty years.

Even more disastrous and far-reaching in effect is Dr. Gordon's investigation in so far as it bears on the mental stamina of the African. He finds that mental disease and weakness is peculiarly prevalent among those who have received an education on European lines. From these facts it has been inferred that European education is not suited to the intellectual capacity of the African, but sets up a series of strains and stresses affecting mental stability which all but the most robust are unable to withstand. Could this contention be shown to hold good generally, it would be an unanswerable argument in support of the views of those who maintain, on quite other grounds, that the present system of education in British Africa is unsuited to native needs.

The problem of the causes which underlie the mental and physical backwardness of the natives of Africa has recently been the subject of correspondence in the *Times*, and the case for immediate investigation was put by Sir Ernest Graham-Little with considerable force in a letter which appeared on August 28. He based his arguments to a great extent on Dr. Gordon's work in Kenya; but he also referred to the material relating to the pathology of the African and "the astonishing multiplicity of diseases in the individual native" given by Dr. J. H. Sequeira in a Chadwick lecture in 1932.

The gravity of the facts bearing on the health and general physical constitution of the native, especially in Kenya, is beyond dispute. Sir E. Graham-Little quotes the figures for child mortality in Kenya as ranging from 125 to 400 per thousand. In one large district, 94–98 per cent

of the children of less than ten years of age show traces of chronic malarial infection, and in a reformatory 75 per cent of the boys were infested with hook-worm, while yaws is almost universal. Pneumonia of pneumococcal origin is especially fatal and widespread. The degree of physical disability among the Kenya natives is illustrated by two recent instances. Among 16,754 men called up for enlistment as carriers, 10,912 were rejected on medical grounds and a further 17 per cent fell out on the march to Nairobi; and in a railway job employing 14,400 men, the death rate was 35·4 per thousand and admissions to hospital were 5,331. While lack of sanitation and ignorance are largely responsible for these conditions, the fundamental cause is generally held to be malnutrition.

While the great value of Dr. Gordon's pioneer work in Kenya is fully recognised, there are those who do not hesitate to question whether these data can be regarded as generally characteristic or his conclusions as widely applicable. When attention was first directed to Dr. Gordon's investigations, we pointed out (NATURE, Dec. 23, 1933, p. 958) that, pending further investigation, certain reservations must be made. The uncertainty attendant on the application of intelligence tests to a native population are notorious, and difficulties of technique which stand in the way of adequate comparison on a racial basis still await satisfactory solution. Sir Grafton Elliot-Smith, in giving his strongest support to the proposed investigation, stressed the lack of comparative data and the difficulties which this lack imposes on investigators such as Dr. Gordon. He was also careful to enter a caveat against undue optimism in regard to the result of this specific inquiry. "No one," he said, "would be foolish enough to suppose that the examination of the brain alone is likely to explain the mental qualities of the native, but it is an essential part of the preliminary reconnaissance for the investigation of a problem of extraordinary difficulty and complexity."

Not only is the problem one of "extraordinary difficulty and complexity", but also it is one in which, it is almost superfluous to state, great issues are involved—issues which inevitably will affect the whole future of a great part of Africa. Upon the investigation of the conditions governing this problem no expenditure of money and energy, as Sir Grafton says, could be regarded as too great.

In one sense the greater part of Africa may be regarded as a vast anthropological laboratory of research. It is sometimes imputed to the science of man as a fault, when it is regarded as a scientific discipline, that, except within certain restricted and well-defined limits, it affords no opportunity for that experimental study which is complementary to observation in the strict canon of scientific method. The issues involved are too grave to admit of experimental interference with human lives for purely theoretical ends. Even observation is restricted by the fact that the life-cycle of man at every stage is too protracted to be readily brought within the focus of many branches of inquiry. Thus in the study of heredity, for example, lower organisms which multiply rapidly and are amenable to controlled conditions must serve as the raw material for generalisation and for the formulation of laws, of which the general applicability, and in this context, of applicability to man, must be accepted as a working hypothesis, subject to the test of further research.

Anthropology, however, is in a more favoured position than other sciences which depend mainly or entirely on observation. For anthropology the whole history of civilisation is a record of experiment—experiment in racial crossing and inbreeding, in cultural conservatism and innovation, in cultural cross fertilisation, in the effect of geographical controls and in the thousand and one other factors and influences which it is the business of the anthropologist, working in the field of archæology and ethnology, to unravel and interpret. It is in proportion as he knows and understands these experiments of the past that he is in a position to formulate laws for future guidance in practical affairs.

In this experimental laboratory, Africa will always hold a prominent place, notwithstanding the inferential character of much of our knowledge of the history of the peoples of the continent. It is a vast field in which over a long period many experiments have been made in racial movement, and in racial crossing, and also in culture contact. In this respect, it is true, Africa differs from Europe and Asia only in degree and not in kind; but its simpler societies and its racially less composite peoples more readily lend themselves to comprehensive observation and analysis than those in regions in which man's life and contacts have proceeded normally on a plane of more intense complexity.

In the greater part of British Africa, for example, the Bantu-speaking peoples, who form

the majority of the population, can be grouped as the product of two predominant racial strains, and their polity analysed as a result of the imposition of the culture of a cattle-keeping people on that of sedentary agriculturists, this fusion producing a peasant-farmer economy, which demands extensive grazing lands, in addition to garden plots, for the full development of its characteristic mode of life. How this piece of history bears upon current problems will be readily appreciated when it is recalled that it has been pointed out in connexion with the native situation in both Kenya and South Africa how the land problem is complicated by the fact that the natives habitually overstock and overgraze their land with disastrous results, but that no method of influencing them in the direction of moderation has as yet been devised. Indeed, one of the most influential of the leaders among the natives of South Africa, while recognising the evil, has declared that on no account must the cattle be touched by the European authorities. The cattle, in fact, are not only their form of wealth but also among their most sacred traditions.

Although much work of exploration and research has been done in Africa, it cannot be said that the factors which may be regarded as 'controls' are fully known, much less understood. Dr. Gordon's pioneer work is only one of many unexplored fields. Little is known, for example, of the racial constituents of the African peoples, for the usual conventional classification which divides the peoples we are here considering, the peoples of British Africa, into Negro and Bantu, with the remains and descendants of Bushmen and Hottentot in South Africa, rests, so far as the Bantu are concerned, mainly on a linguistic classification which covers a wide variation in physical character, generally regarded as due to Negro admixture with other strains not too clearly identified. In the investigation of the conclusions put forward by Dr. Gordon, racial questions will obviously become of no little practical importance. But the more the ethnology of Africa, the record of past experiment, becomes known, the more clearly does it become apparent to how great an extent does it enter into the practical problems of to-day.

Some indication of the far-reaching importance of investigations such as these are furnished by a recent publication*, edited by Dr. I. Schapera, on present conditions among the natives of South Africa. It consists of a series of chapters, in which (with the single exception of a chapter contributed by the editor dealing with the traditional culture of a typical South African tribe), a number of experts deal with various aspects of present-day life among the native population. Although each contributor has been left free to express his opinion on present conditions and to suggest, if he will, lines of amendment of present policy, the general tone is one of impartiality. The book may in fact be regarded as a scientific study of the natives of South Africa very much on the lines of a treatise in functional anthropology. Its value for the understanding of the native problem in South Africa is very considerable; but its mention here is justified rather on the ground of its bearing on the problem of British Africa as a whole, in so far as it is possible to reduce to a single formula the multifarious problems, which are individual in every people, if not almost in every tribe.

Broadly speaking, it is not unfair to say that native policy in South Africa has been a failure. This applies equally to the phase which regarded the proper relation with the native as a process of converting him into a dark-skinned European, and to the later policy which aimed at the segregation of the native from the white population, and since 1926 in all the provinces, following the example of Natal, has administered the affairs of the native in accordance with native ideas and institutions very much on the lines of 'indirect rule'. The lessons of the failure of the segregation policy are not without their moral for 'indirect rule' elsewhere. As time goes on, it becomes increasingly apparent that it can be no more than a stage in a direction which has still to be determined. This is, on the whole, the lesson of segregation. In South Africa, not only has complete segregation been impossible, owing to the number of urbanised natives; but also it has, so far, failed to afford the native the opportunities for development which were hoped from it. This is due to idiosyncrasies of Bantu culture which resist change, rather than to intellectual inferiority or incapacity, and would appear to suggest that the true end to which such policies as segregation or 'indirect rule' may lead in order to allow full play to the undoubted abilities of the native has still to be found. In this quest the investigation now suggested by Sir. E. Graham-Little may well be the first step.

* Western Civilization and the Natives of South Africa: Studies in Culture Contact. Edited by I. Schapera. Contributors: I. Schapera, W. M. Eiselen, W. G. A. Mears, G. P. Lestrade, Percival R. Kirby, H. M. Robertson, J. D. Rheinallt Jones, W. H. Hutt, Edgar H. Brookes, R. F. Alfred Hoernlé, D. D. T. Jabavu. Pp. xiv+312+12 plates. London: George Routledge and Sons, Ltd., 1934.) 15*s.* net.

The Native and his Industries in Northern Rhodesia*

By PROF. ALAN G. OGILVIE, O.B.E.

EVER since geography was re-established as an organised discipline, the essence of which is the study of terrestrial distributions and their inter-relations, geographers have been sifting and collating data of extremely varied character. The facts which have thus been incorporated in the body of geographical literature have themselves usually been established by workers in other fields, while geographers have drawn deductions from them, in many cases without having the opportunity to test their validity on the ground. As a result, generalisation and causation in regard to very large sections of the continents must necessarily rest on a rather insecure foundation. The question therefore arises—how can this be remedied ?

The basis of our knowledge of large parts of the southern continents and of Asia depends largely upon the accounts of primary exploration, some of the best of it contributed by the great pioneers, the naturalist travellers of the nineteenth century. Since their day the mesh of the net has become closer ; but the records of exploration having the character of traverses must nearly always be limited, since observations are usually confined to one season of the year.

The suggestion which I have to offer applies rather to regions where pioneer exploration is regarded as finished, and especially to the colonies and dependencies of the more advanced nations. I submit that these regions offer the most fruitful field for geographical research in the nearer future. As the chief reason for this belief I would mention the justifiable hope of the rapid extension of systematic surveys in such countries ; and we are agreed, I think, that the basis of all sound geographical research is a reliable topographic map, supplemented if possible by the results of geological surveys.

Let us consider Africa as an example, with special attention to its inhabitants. Anthropological literature has dealt very fully with the African races and is prepared to answer most of the questions that are usually asked relating to the natives. Nevertheless, the geographical controls or influences affecting the material life of these peoples usually receive far too little attention. Indeed, the physical environment as a rule is quite inadequately treated in the anthropological literature of the continent. A Research Committee of the British Association was therefore appointed after the Oxford meeting in 1926 to investigate the state of knowledge of the human geography of inter-tropical Africa ; and this Committee has been increasing its activities ever since. It set itself to state clearly the points upon which information was badly needed, and then proceeded to lay plans for tapping a body of knowledge which it believed to exist in Africa, but which hitherto had scarcely been tapped in the interests of geography. Scattered throughout this continent are many men and women, chiefly the district officers of Colonial Governments and missionaries, who, with long residence in close contact with the Africans and personal experience of the environmental conditions year in year out, should be able, by answering specific questions, to provide the essential link between the land and the mode of life of the natives. To them the Committee sent nineteen questions, most of which might be considered to apply to any of the regions envisaged.

HUMAN GEOGRAPHY OF NORTHERN RHODESIA

The most comprehensive response received so far has come from Northern Rhodesia, with the result that the Committee has at its disposal a series of thirty reports by the District Officers of the Protectorate covering nearly the whole territory.

The inquiry has elicited certain facts about the modification of the natural vegetation by the natives. The great majority of the people live upon their crops, and most of these are raised in partial clearings of the savanna. The natives are truly men of the trees, apart from which they cannot live. The essential feature of their system of shifting agriculture is the annual felling or pollarding of trees, and the application to the soil of the ash derived from burning the wood on the site of their gardens. The area of woodland cut for a garden of given size of course depends first upon the luxuriance of the trees, and secondly upon the nature of the practice—whether pollarding or felling. The estimates of the ratio of timber area cut to area of garden vary between 4 : 1 and 10 : 1. The estimates of the period required for recovery of the woods are more numerous, but they are difficult to interpret in view of the inadequate accounts of the vegetation. Several District reports mention rest periods as short as four or five years ; in others these are between ten and twenty, and in Barotse thirty to thirty-five years.

The degree in which the savanna has degenerated under this system of agriculture depends largely

* From the presidential address entitled "Co-operative Research in Geography, with an African Example" to Section E (Geography) of the British Association, delivered at Aberdeen on September 6. The full address is being printed in the November issue of the *Scottish Geographical Magazine*.

upon the density of the population. Many writers point out that tracts of the natural vegetation still exist simply because the population is small—as, for example, in Chinsali with three per square mile. But such figures are misleading, for the actual densities on land desirable from soil and water qualities are very much greater. Moreover, the native cuts wood for many purposes besides that of manuring his garden. Finally, there is the damage to seedlings and young trees caused by the annual grass fires which sweep the territory, started for various reasons.

External Influences

The effect of European influence upon the economic and social structure of native society in Northern Rhodesia has recently been very thoroughly dealt with by Mr. Merle Davis. Yet it is interesting to attempt an estimate, based upon our District reports, of the nature and degree of external influence upon the material life of the natives. The use of manioc (*Cf.* Fig. 3), and the square or oblong type of house which to-day prevails in the north-west, seems to result from indirect contacts with the Portuguese on the Atlantic seaboard. Since 1917, the new wave of immigrants from Angola has led to the spread of this house type throughout the upper Zambezi basin.

Much more important are the influences due to British rule and partial settlement by European farmers, the rapid exploitation of minerals in the Belgian Katanga and the Ndola and Broken Hill Districts of the Protectorate; while the establishment of missions throughout Rhodesia has had widespread material as well as moral effect. Indexes of the outward evidence of this permeation are: the distribution of houses built on the European pattern; the continuance or otherwise of the old-established native iron industry; and the direction and volume of movement of native labour to work for Europeans (Fig. 1).

It is evident from the reports that while European influence is greatest along the central railway belt, yet the attraction of the mines as a source of employment and a market for surplus food is widespread, though variable, throughout the Protectorate. A universal effect of the new security is the replacement of the old stockaded village of large size by smaller groups varying according to local geographical conditions.

Population Density

The average density of population for the whole Protectorate is a little more than four per square mile; but it is unevenly distributed. Thus, two Districts in Barotse Province, Kalabo and Mongu, have densities of 11·6 and 16·3 respectively; Chienji on Lake Mweru has 13, while Fort Jameson has 20·8. On the other hand, in a belt from the Katanga border southward to Sesheke the District densities vary from 1·3 to 2·5, while in the railway belt to the east of this, figures are between 3 and 4.

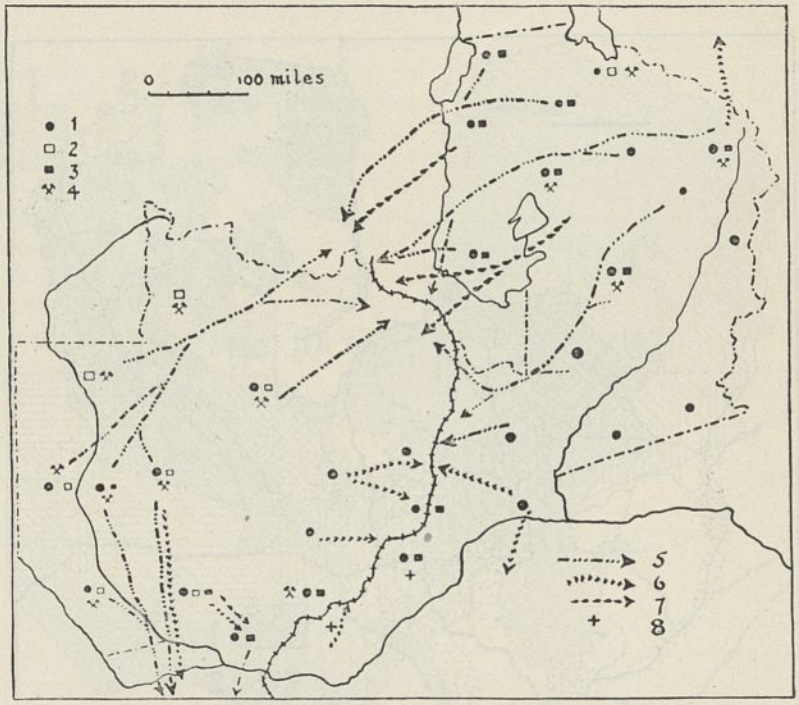

FIG. 1. Cartogram of Northern Rhodesia to illustrate effects of external influences. (1) Rhodesian circular house; (2) rectangular house of Bantu or Swahili origin; (3) rectangular house on European model; (4) native iron industry reported as still in operation; (5) annual migration to European mines and (6) to other European employment and (7) to market produce; (8) surplus produce sold locally.

But it is the examination of life conditions which brings realisation of the real arrangement of the natives. For example, in Mkushi they live along the river valleys with a probable density of 50–60 per square mile instead of 2·77 for the District.

The type of locality which carries the greatest population is that which provides a means of livelihood apart from agriculture; and fishing is by far the most usual supplement of this kind. Indeed, it becomes the dominant occupation around Lakes Bangweolo and Mweru, where the islands and shores have about 80 persons per square mile. Such areas of good fishing which are also excellent land for producing manioc have received access of population in recent years on account of the

encouragement to market fish and meal in the mining areas to the west. The great alluvial plains of the Barotse, the Kafue Flats, and the reserves east of the Luangwa are all relatively populous districts in which cattle are held by cultivators. Apart from the areas mentioned and a few others less notable, the population densities, calculated on the assumption of stream-bank arrangement, would seem to vary from, say, 5–10 per square mile in Districts of small population to 40–50 in the more populous.

Tsetse Fly

No element of the human environment is more important than the distribution of the tsetse flies

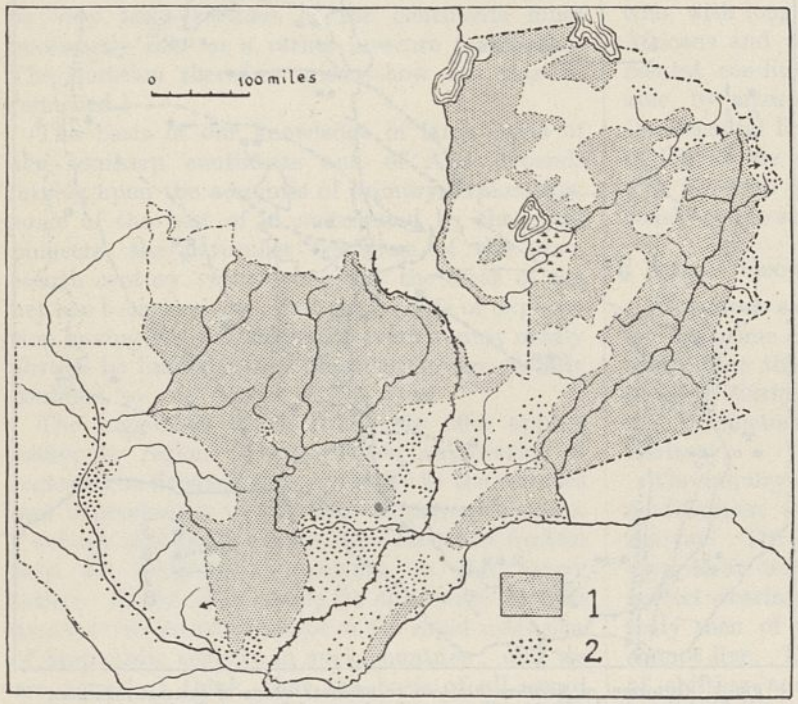

Fig. 2. Sketch-map of Northern Rhodesia, showing distribution of (1) tsetse fly and (2) native-owned cattle.

(*Glossina*). *G. palpalis*, the carrier of sleeping sickness, appears happily to be either absent or innocuous over nearly all the country. But with the bearers of *Nagana* it is quite otherwise. Their distribution, as plotted from the reports and certain local maps, reveals three large tracts that are free of fly. The first includes the greater part of Barotseland. East of this lies a broad fly belt; within this the flies seem to be spreading, and at the southern end the belt is extending both eastward and westward toward the native and European cattle land of the lower Kafue and the railway zone. This latter, with its greater amount of cultivated land, is still free of fly to the edge of the great escarpment, and the same is generally true of its continuation north-eastward along the divide between the Chambezi and Luangwa; Broken Hill and Mkushi even report a reduction in fly. The Luangwa fly belt shuts off the clear area of the Nyasaland border, and at the head of the valley the pest is encroaching on the plateau land. The tsetse distribution is more patchy in the northern areas. Generally speaking, the higher lands are the freer. In Fort Rosebery the fly is local, and Kasama records a reduction; but evidently there are few areas which can safely be reached by cattle.

Fig. 2 indicates clearly the prevalence of tsetse in the hot lowlands, but the controlling factor on the plateaux, which is doubtless the character of the vegetation, cannot be examined until a survey of that element has been made. The nature of the wild fauna is a contributory factor; and while the reports contain useful information regarding the wild animals which are hunted or cause depredations to crops, it is insufficient to allow of any important deduction.

Cattle

While cattle are restricted to the areas free of fly, they are by no means evenly distributed throughout these parts. Nor are they of equal significance in the life of their owners, chiefly on account of varying tribal tradition in regard to cattle, but also from the incidence of European influence. In Barotse the herds vary according to the available pasture, being greatest on the Zambezi plain (in Mongu *circa* 50,000 head) and decreasing north and south. Cattle in general are regarded merely as wealth, chiefly in relation to the marriage security, sometimes as a source of meat and of hides, more rarely of milk. But in contact with Europeans and a market, the tribesman tends to devote his animals to work, notably with the acquisition of the plough in the alluvial plains, of two-wheeled carts on suitable ground and of sledges elsewhere. It is chiefly in the vicinity of the railway that the natives are following European guidance in the matter of breeding and of dipping. Elsewhere the herds receive little attention, and consequently the stock is poor. Furthermore, the Barotse cattle were stricken with pleuro-pneumonia in 1915 and their numbers reduced by perhaps 50 per cent. In the central

Districts, on the other hand, stock is increasing, owing to the natives' contact with Europeans. Here there is some danger from overstocking, which reacts not merely directly on the animals, but also results in rapid erosion of the soil wherever there are slopes.

Transhumance is practised by the cattle owners of the Barotse Plain and the Kafue Flats, in each case in response to the flooding of the alluvial belt; and in each case this has great effect upon the social and economic life of the tribes concerned.

Food Staples

The distributions of four of the leading food crops of Africa meet and overlap in Northern Rhodesia; the three cereals, comprising the great millet (sorghum), the lesser millets, of which eleusine is the most important, and maize. These, with manioc (cassava), form the food staples of the native population. Allowing for some uncertainty as to the identity of the millets mentioned by the authors of reports, it has been possible to plot the crop distribution with general accuracy (Fig. 3). It is thus evident that the small millets, especially eleusine, prevail in the north-eastern plateau, while sorghum is more cultivated in the central Districts. This crop, however, has yielded the first place over most of its area to maize, most probably introduced from the south and certainly increasing where the contact with European farming is close. The most outstanding fact elicited is the penetration of the territory by manioc as a staple crop. The lower Congo region is generally held to have been the centre of dispersion of this American plant, and it will be interesting to learn whether its area is now unbroken to the Rhodesian border. It is clear that manioc is still being carried south-eastward by the Angolan immigrants in Barotse, and, for several reasons, its cultivation is being encouraged elsewhere by the administration. The dependence upon these crops is closely related to the distribution of soil and vegetation types, to the incidence of rainfall and to the annual flooding of the rivers.

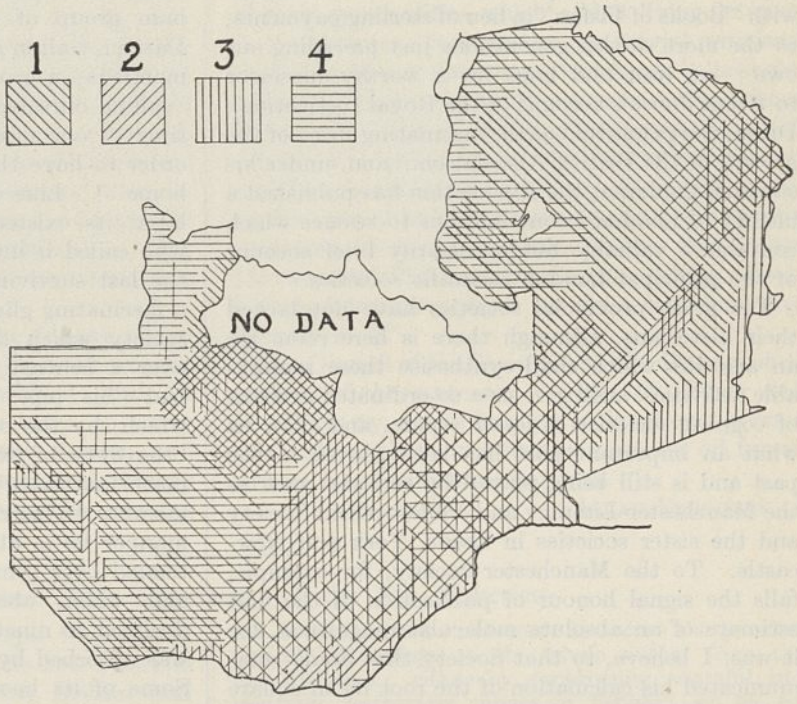

Fig. 3. Cartogram of Northern Rhodesia, showing distribution of leading food staples. (1) Small millet, generally eleusine; (2) sorghum; (3) maize; (4) manioc (cassava). For sake of visibility, lines have been drawn over European as well as native areas.

In addition to the matters referred to, this piece of co-operative research in human geography has yielded much information upon animal pests and the amount and nature of hunting; upon fishing in relation to the rise and fall of rivers; upon the seasonal migrations in search of fish and various food relishes. Most important of all is the whole subject of seasonal rhythm of occupation and its regional variations, a matter upon which the reports are of great service.

It is much to be hoped that surveys of the other African territories will be undertaken. Moreover, I am looking beyond Africa to countries where many Europeans reside, people who may never have thought of geography as we regard it, but who might well be sufficiently interested in the land of their choice to be willing to take part in the kind of team work which I have outlined. Take India as an example. In spite of voluminous official and other literature, we have still a great deal to learn of the geography of man in the sub-continent. Although the task of gathering the information there would be much more complex than in the case of Africa, there would be certain offsetting advantages. Among these are: the accuracy of the map of India, the existence of a great body of data created by the various scientific services, and a wonderful census organisation. In addition, there is the likelihood that men of science could be found on the spot who would be able to fill in the gaps in the picture of the physical environment. These might be asked to deal with the numerous connecting links which are not usually required for official departmental reports, but are, nevertheless, essential to the geographer.

Societies and Centenaries

A STUDY of the history of those societies whose interests are in the main scientific and literary would form a task pleasant enough and, in all conscience, comprehensive enough for a student of the development of scientific thought. Even if we restricted ourselves to a study of our own national societies, the field would be sufficiently wide to tax the energies of a single worker. A start has been made. Weld (the works of Sprat, Birch and Thomson can scarcely be termed histories) has traced the origins and the varied fortunes of the Royal Society from the struggling days when its unlucky secretaries were threatened with "Books of Fishes" in lieu of sterling payments, to the more settled generations just preceding our own; we wait and hope for a worthy successor to Bence Jones's account of the Royal Institution; Dr. Howarth has told us the fascinating story of the growth of the British Association; and, under his editorial guidance, the Association has published a history of London's contributions to science which contains a valuable but necessarily brief account of the principal London scientific societies.

The great provincial societies have not lacked their historians, although there is here room for an account which shall synthesise these remarkable activities, shall give us a co-ordinated account of cognate societies of lesser repute, and show us what an important part has been played in the past and is still being played by societies such as the Manchester Literary and Philosophical Society and the sister societies in Leeds, York and Newcastle. To the Manchester society, for example, falls the signal honour of publication of the first estimate of an absolute molecular magnitude, for it was, I believe, to that Society that Joule communicated his calculation of the root mean square velocity of a molecule of hydrogen at standard temperature and pressure (the value he gave was 6,055 ft. per second; Childs' tables give 6,037 ft. per second).

In connexion with such societies, it is in the nature of things that our own generation should have witnessed a flood of jubilees and single, sesqui- and bi-centenaries; and it is to the credit of the societies concerned that they should hasten to give to the world some account of their origins and growth, the celebrations becoming something more than an occasion for a series of such gargantuan feastings as are permitted to a post-War world. But there are other societies, some still in existence, some vanished and gone, of which we know little beyond their names, *carent quia vate sacro*. Of some, indeed, we may find a record in rare volumes and obscure appendixes, but here again we could wish for a modern synthesis of their activities which should place in its proper perspective the not uninteresting story of their growth and decay.

What of that Society for Philosophical Experiments and Conversation the minutes of which for the year 1794 are printed for T. Cadell, Junior, and W. Davies (successors to Mr. Cadell) in the Strand—a society which was instituted in London on January 25, 1794, at the house of Dr. Higgins, and held weekly meetings during the session of Parliament under the chairmanship of Field Marshal Conway—the "Didactic Experimenter" being Dr. Bryan Higgins? What of that Birmingham group of which Priestley, Watt, Boulton, Darwin, Galton and Wedgwood were distinguished members—a group which met at dinner monthly "calling ourselves the Lunar Society, because the time of our meeting was near the full moon, in order to have the benefit of its light in returning home"? Like the famous x club of a century later, its existence depended on those members who called it into being, and Watt was probably the last surviving member. De Morgan gives us a fascinating glimpse of that artisan mathematical society which flourished in Spitalfields for well over a century, a society in which every man had "his pipe, his pot and his problem"; in which, by the constitution of the society, it was "the duty of every member if he be asked any mathematical or philosophical question by another member, to instruct him in the plainest and easiest manner he is able". The society's existence extended over some one hundred and thirty years, and when, about 1845, its membership had declined to nineteen, the society, with its library, was absorbed by the Royal Astronomical Society. Some of its books, duplicates of those possessed by the Royal Astronomical Society, are to be found in the library of the Physical Society. In its mature years, the society was live and lively. Tempers ran high at times, and we read that "if any member shall so far forget himself and the respect due to the Society as in the warmth of debate to threaten or offer personal violence to any other member, he shall be liable to immediate expulsion, or to pay such fine as the majority of members shall decide".

So much for societies dead and gone; the centenary of the Royal Statistical Society, the circumstances of the origin of which are of special interest in view of the happenings of to-day, has been marked by the production of a history of the Society*. At the Cambridge meeting of the

* Annals of the Royal Statistical Society, 1834–1934. Pp. xii+308+8 plates. (London: Royal Statistical Society, 1934.) n.p.

British Association in 1833, a group of enthusiasts formed, somewhat irregularly, a new statistical section. The presence of Quetelet had something to do with its formation, and the new section was recognised by those in authority, although it can scarcely be said to have received their blessing. The president, Adam Sedgwick, delivered himself of some good advice in the rotund style of the day, informing the culprits that because of the irregular circumstances of its formation he would not read the report of this "self-formed Section", and reminding his hearers that "the things with which the Association had to do were the laws and properties of matter and with those alone". Statistical inquiries might be admitted so long as they dealt with "matters of fact, with mere abstractions and with numerical results. . . . These inquiries, however . . . touched the main-springs of passion and feeling . . . they blended themselves with the generalizations of political science; but when they entered on these higher generalizations that moment they were dissevered from the objects of the Association and must be abandoned by it if it meant not to desert the secure ground which it had now taken. . . . The daemon of Discord would find his way into their Eden of Philosophy."

As the historians of the Society remark, there was more to the same effect. It is small wonder that the Statistical Section resolved that "a more permanent body was necessary to carry out the views and wishes of the Section and it was agreed to establish a Statistical Society in London". Hence arose that public meeting of "Noblemen and Gentlemen" at 21 Regent Street, on March 15, 1834, which marked the beginning of the long and honourable career of what is now known as the Royal Statistical Society.

The annals of its development, as recounted in the scholarly pages of the centenary volume, are absorbing, if unexciting. The progress of the Society is traced with admirable clarity from these modest beginnings to a stage at which, amid a host of other activities, it is playing an important part in forwarding the application of statistical methods to various problems of industry, and the accounts of the work of those eminent statisticians who have cherished the interests of the Society in the past are associated with pleasant little sketches of their personalities which add a living interest to the picture. Perhaps the one trivial criticism, if criticism it may be termed, which can be brought against a wholly delightful volume, is that there are scarcely enough of these touches. We could wish that a president of the Statistical Society could be found who should say of a dull paper, as the venerable Dalton announced in an audible undertone from the rostrum of the Manchester Literary and Philosophical Society, "Well, this is a varra interesting paper for those that take any interest in it".

The Council of the Society, and the distinguished authors of the centenary volume, Dr. Bonar and Mr. Macrosty, are to be congratulated on the issue of a volume that must form a norm for all future writers faced with a similar task.

ALLAN FERGUSON.

Science and State Regulation of the Sea Fisheries

ON September 22, 1863, a Royal Commission commenced inquiries into the Sea Fisheries of the United Kingdom of Great Britain and Ireland. Prof. T. H. Huxley and his fellow commissioners visited eighty-six places, examining methods of fishing in use and interrogating witnesses. Their Report, published in 1866, was a masterly summary of the situation, embodying courageous recommendations in accordance with a declared legislative principle. The first recommendation was as follows:

"We advise that all Acts of Parliament which profess to regulate, or restrict, the modes of fishing pursued in the open sea be repealed; and that unrestricted freedom of fishing be permitted hereafter."

And the principle:

". . . that (apart from the restrictions prescribed by international law, or by special treaties) the produce of the Sea is the property of the people in common; and that methods of fishing are fitting subjects for legislation, only so far as such legislation can be shown to be necessary to secure the greatest possible advantage to the whole nation from the Sea Fisheries; either by suppressing wasteful and uselessly destructive modes of fishing; or by removing legislative obstacles in the way of improved modes of fishing; or by preserving peace and order among fishermen."

Broadly speaking, the great deep-sea fisheries of the present day have been developed under that "unrestricted freedom of fishing" advocated by the 1863 Commission, without let or hindrance in the form of national or international regulation. The passing into law of the Sea-Fishing Industry Act of 1933, therefore, by granting State control over fishing operations, marked the end of nearly seventy years of free fishing by British vessels in the high seas.

By this Act, the British Government has acquired powers to regulate and restrict the fishing of British vessels whereby fishing grounds, times of fishing, fishing gear, quantities of fish to be landed and their quality—all of these being matters over

which the fishermen formerly exercised freedom of action—are brought under State prescription. Landings of foreign-caught fish are also regulated. Furthermore, by the same Act, the Sea-Fish Commission for the United Kingdom came into being, to investigate and advise the Government as to whether any, and if so, what, steps ought to be taken for reorganising any branch of the nation's sea-fishing industry. One of the first services of this Commission has been to present a Report on the Herring Industry[1], recommending the establishment of a Herring Board having far-reaching powers.

Now it cannot be denied that the Sea-Fishing Industry Act was passed, primarily, to rehabilitate an industry most grievously hit by the general economic depression, but it would be a profound mistake to adjudge the Act solely as a measure to meet business exigencies. Indeed, there appears no escape from the conclusion that, unless the fundamental legislative principle laid down by the Royal Commission of 1863 has been put aside, the Act is nothing less than an indictment of the fishing industry for its "wasteful and uselessly destructive modes of fishing".

In this connexion, the findings of the International Council for the Exploration of the Sea during the meetings held at Copenhagen in June last, are of outstanding significance. Delegates and experts from Belgium, Denmark, Finland, France, Germany, Great Britain, Holland, Norway, Poland, Portugal and Sweden, arrived at fifteen conclusions which were accepted and adopted, with slight amendments, by the Council on June 9. Nine of these conclusions, as they appear in the (amended) Authentic Text[2], are given below :

(1) It is important, for the maintenance of the stock, that measures to prevent waste be taken by all countries fishing in the waters included in the Council's investigations.

(2) The most useful measure of control will take the form of prevention, as far as possible, of the capture of young fish below the size at which they can be sold at a remunerative price for the food of man.

(3) It has been shown that, in the case of the trawl net and Danish seine, appreciable protection of young round-fishes can be secured by regulating the size of mesh of the bag or cod-end. This method needs to be further elaborated, but enough experience has been gained to justify a minimum size of mesh which should be required in the construction of the bag or cod-end employed in the open sea.

(4) The minimum mesh which the Council recommends is that already enforced by the regulations of the British Government, which, they are satisfied, will ensure the release of an appreciable quantity of undersized fish now captured and retained.

(5) No way at present practicable of regulating the mesh has yet been devised which would secure the release of flat-fishes up to the sizes at which they ought to be protected and would not release marketable round fish.

(6) It is, therefore, desirable that size-limits should be imposed for flat-fishes in order to discourage fishing on grounds where small flat-fishes form the greater part of the population.

(7) The imposition of size-limits is also desirable for round-fishes, in order to re-inforce the mesh-regulations, and to remove the temptation for fishermen to evade these regulations when at sea.

. . . . .

(12) The Council recommends the adoption by all countries, as soon as possible, of size-limits not less than those required by British regulations. It is of the opinion that experience will show that some of these might be usefully extended, and that size-limits might also be introduced with advantage for other fishes, especially cod. It wishes, however, to emphasize the fact that the chief thing to aim at is the prevention of the *capture* of undersized fish, and that accordingly the regulation of fishing should take first place.

(13) The Council recognizes the difficulty of enforcing different measures of protection for different areas and different fisheries ; but it considers that, when the question of increasing the minimum measures now proposed arises, this question will have to be faced and solved.

From these conclusions of competent scientific representatives of all the leading fishing nations of Europe, it would surely seem that the Sea-Fishing Industry Act was not only right in its indictment of wasteful fishing, but also in the methods by which it sought to check this waste. It is especially gratifying, therefore, that the trawling industry has so cheerfully co-operated with the Fishery Departments of the Government to secure the smooth working of the Orders already imposed under the Act, despite the fact that the fishermen of other nations, working the same fishing grounds, have remained free from such regulation. This very circumstance may well prove to be one of the strongest factors in inducing the Governments of Europe to follow the British lead towards the maintenance of fish-stocks at an adequate level, and to ensure that they are utilised in the most economic manner.

Finally, it should not be lost to view that the vitally important conclusions of the International Council were based on knowledge derived from thirty-two years of scientific investigation in which the nations have co-operated. With the fisheries brought under legislative control, the need for scientific surveillance will be greater than ever, not only to perfect the means of protection against wasteful fishing, but also to preserve the fisheries from that purely obstructive legislation which Huxley so fearlessly and rightly condemned.

E. F.

[1] Sea-Fish Commission for the United Kingdom. First Report : The Herring Industry. (Cmd. 4677.) Pp. 51. (London : H.M. Stationery Office, 1934.) 9*d*. net.

[2] Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 90 : Size-Limits for Fish and Regulations of the Meshes of Fishing Nets. Pp. xv+61. (Copenhague : Andr. Fred. Høst et fils, 1934.) 3.00 kr.

Obituary

SIR ARTHUR SCHUSTER, F.R.S.

ON Sunday, October 14, Sir Arthur Schuster passed away at Yeldall, his home near Twyford, Berkshire, after a long and distressing illness. Thus is broken one of the few remaining links with the physics of the second half of the nineteenth century.

Sir Arthur Schuster was a member of a Frankfort-on-Main family which, so early as the middle of the eighteenth century, had established a business in cotton goods in England. His father, while retaining an interest in the English business, founded a successful banking firm in Frankfort-on-Main; but in 1869 he removed with his family to England, taking charge of the Manchester branch of the firm of Schuster Brothers. Arthur Schuster was born in Frankfort on September 12, 1851, and spent the first sixteen years of his life in that town. He received his early education in the Gymnasium and then was sent to Geneva where, during two happy years, he studied French and attended lectures at the "Academy". In 1870 he joined his parents in Manchester and entered his father's business. There can be little doubt that his experience during these early years had a great influence on his future life, for he gained a complete mastery of the English, French and German languages and, although against the grain, learnt something of business methods.

Schuster was not happy in the business; he found more pleasure in attending evening classes at the Owens College, and in less than a year he had induced his father to let him take up science as his life's work. He now entered Owens College as a day student, and for a year studied under Balfour Stewart; and then having become interested in spectrum analysis he went, on the advice of Roscoe, to Heidelberg to study under Kirchhoff. He spent two years in Heidelberg, obtaining his Ph.D. in 1873.

On his return to Manchester, Schuster found that Owens College had been removed from its cramped and primitive quarters in Quay Street to its present site, where three rooms in the basement had been set aside as a physical laboratory. Balfour Stewart was still the professor of physics and Schuster became his unpaid demonstrator. Little did Schuster foresee, as he worked in the three-room laboratory, that only twenty-seven years later he himself would be the professor of physics with a laboratory, built to his own design, consisting of forty rooms. But at this time Schuster had no intention of settling down at Manchester; that was to come seven years later. In the meantime, he studied at Göttingen under Wilhelm Weber and Riecke and at Berlin under Helmholtz; led (at twenty-four years of age) the British eclipse expedition to Siam; put in another year as honorary demonstrator at Manchester, when —as he was proud to recall—he gave a course of lectures on Maxwell's theory of electricity which was attended by J. J. Thomson; worked for nearly five years at the Cavendish Laboratory, Cambridge, first under Clerk Maxwell and later under Lord Rayleigh; and during the summer vacation of 1878 took part in his second eclipse expedition, this time to Colorado.

In 1881 a professorship of applied mathematics was founded at Owens College and Schuster was appointed to the chair. He held this professorship for seven years, during which his work was physics rather than mathematics, and he took part in two more eclipse expeditions, to Egypt in 1882 and to the West Indies in 1886.

In 1888 Balfour Stewart died and Schuster was appointed to succeed him as Langworthy professor of physics in the Owens College, a professorship which he retained until his retirement in 1907, when he was succeeded by Lord Rutherford. Thus Schuster's association with Owens College, Manchester, was a long one, commencing when he first attended Roscoe's lectures as a night student in 1870, and terminating in 1907 after he had been professor of physics for twenty-six years. It was a period of great development: in 1873, when Schuster first taught in the laboratory, there were only about ten students; when he retired in 1907 there were about 150 students taking elementary courses and 100 doing more advanced work.

Schuster commenced his active scientific life just at the time when physical laboratories were being established at the British universities and, as we have already seen, he worked in two of them in their very early days. The period of qualitative discovery of new physical phenomena appeared to be over: the main facts of electricity, magnetism, optics, spectrum analysis, etc. were known; and, as a matter of fact, no further discovery of a fundamental nature was made until the discovery of Röntgen rays at the end of 1895, by which time Schuster's period of active research was nearing its end. Schuster's scientific work was, therefore, concerned almost entirely with what may be called the 'old physics'; but he lived long enough to follow with the greatest interest and pleasure the progress of the 'modern physics' in which his old laboratory at Manchester has taken such a distinguished part.

It has already been mentioned that Schuster, while still a student, was attracted to spectrum analysis, and his first paper, published when he was twenty-one years of age, was on the spectrum of nitrogen. It was spectrum analysis which gave him his interest in eclipse work, and on his third eclipse expedition he succeeded in photographing the spectrum of the solar corona for the first time. Laboratory work on spectra, mainly the spectra of gases in Geissler tubes, naturally led him on to problems connected with the discharge of electricity through gases, on which subject he wrote many papers and delivered two Bakerian Lectures (1884 and 1890). He was the first to attribute the conductivity of gases at low pressure to the formation of gaseous ions, and he made the first determinations of e/m by means of the magnetic deflection of cathode rays, but did not obtain a good result.

Schuster became more and more interested in what we now call geophysics, and the relationship between geophysical and solar physical phenomena. One of his most important papers was an analysis of the daily variation of terrestrial magnetism, in the course of which he proved that the electrical currents responsible for the daily magnetic changes were external to the earth ; and in a later paper he showed that qualitatively these currents could be explained by the induction currents which would be set up by the daily variation of the barometer if the upper atmosphere were highly conducting. This was a development of a suggestion made previously by Balfour Stewart and was itself the forerunner of Heaviside and Kennelly's explanation of the propagation of wireless waves around the earth. Schuster made other valuable contributions to the theory of terrestrial magnetism and was particularly interested in the relationship between magnetic storms and the processes taking place on the sun.

Schuster did not himself carry out investigations in seismology ; but he was deeply interested in this branch of geophysics and was for some time chairman of the Seismological Committee of the International Association of Academies and served on other committees both international and British dealing with seismology. In 1910 he presented a set of Galitzin's horizontal seismographs to Eskdalemuir Observatory. In 1925 these instruments were transferred to Kew, and during the last few years in particular their records have been the subject of intense and very productive original work.

Meteorology was always a favourite subject with Schuster, and he gave much time and thought to the organisation and administration of the Meteorological Office. In 1900 he was appointed by the Royal Society to be an additional member of the Meteorological Council, the Meteorological Office then being under the control of the Royal Society. When the constitution of the Office was changed in 1905, Schuster became the Royal Society's representative on the new Meteorological Committee, a post which he held until November 1932, when his failing powers made it no longer possible for him to serve. Thus for more than thirty-two years Schuster sat on the governing body of the Meteorological Office, seldom missing a meeting, and taking intense interest in the development of the meteorological service. He also showed his interest in meteorology by persuading the University of Manchester to establish in 1905 a University lectureship in meteorology, the first post for the teaching of meteorology in a British university, and at his own cost he established in 1907 a readership in meteorology at Cambridge.

No one will question Schuster's eminence as a man of science ; but it is doubtful whether he was not an even greater administrator. It was impossible for Schuster to be connected with any undertaking without being called upon to take part in its organisation and administration. During the whole of his association with Manchester, he was a leading spirit in all University affairs and he took a large part in the movement for the conversion of the old Victoria University into three independent universities in Manchester, Liverpool and Leeds. He was elected a fellow of the Royal Society in 1879, at the early age of twenty-eight years, and always took a prominent part in the work of the Society. He served two periods as an ordinary member of Council and was secretary for seven years (1912–19) embracing the difficult period of the War. On retiring from the secretaryship he served on the Council for five more years, first as vice-president and then as foreign secretary. He received a Royal and a Rumford Medal from the Society, and eventually, in 1931, the Copley Medal. He was also an active member of the British Association, serving as president of Section A (Edinburgh, 1892), of the Sub-section of Astronomy and Cosmical Physics (Belfast, 1902) and finally of the whole Association at Manchester in 1915. It would be tedious to enumerate all the committees, commissions and conferences on which he served ; but mention must be made of the Royal Commission for the Universities of Oxford and Cambridge under the chairmanship of Lord Oxford and Asquith, in the work of which he was deeply interested.

There is still another side of Schuster's life to relate, and one to which he devoted the greater part of his time after retiring from the professorship at Manchester. I have already mentioned that Schuster's education had given him complete command of the three main European languages. He was always fond of travel and became personally known to the leading men of science in all parts of the world. Also his family connexions were international rather than national. Thus he was by circumstances, training and temperament eminently fitted to take a leading part in the international organisation of science. It is not surprising therefore that he should be sent by the Royal Society as delegate to the preliminary meeting held at Wiesbaden in 1899, for the organisation of the International Association of Academies. He took an active part in the subsequent formation of that Association and in 1905 was appointed by the Royal Society to be the representative of the Society on its Council. To facilitate Great Britain taking a proper share in the work of the International Association of Academies, Schuster endowed the Royal Society with a fund of £3,500, the income of which was to be used in paying the annual subscription to the Association and in defraying the expenses of delegates.

The War destroyed the International Association of Academies, much to the distress of Schuster ; but even before the end of hostilities, he commenced to build up again an international organisation for science by the foundation of the International Research Council, of which he became the first secretary, an office he held from 1919 until 1928. It is impossible here to give any details of Schuster's struggles after the War to re-establish real international co-operation in science ; trusted by both French and German men of science, no one was more fitted to bring about an understanding ; but circumstances were too strong, and even to-day the breach caused by the War in international co-operation amongst men of science is far from being repaired.

For a man of his outstanding ability and force of character, Schuster was of a very retiring nature. It was not easy to get to know him well; his manner was reserved and he had a disconcerting habit of letting his mind wander—or appear to wander—from the subject of conversation. But all of us who came into close contact with him knew how superficial these mannerisms were: behind them there was a lively human interest and a great desire to help. Few professors took a more active interest in their students, and in this he was ably assisted by Lady Schuster, whose hospitality at Kent House in Victoria Park, Manchester, is a happy recollection of all those who studied under, or worked with, Sir Arthur in Manchester. An outstanding characteristic was Schuster's loyalty to his friends, for he never lost an opportunity of advancing the career of anyone who had gained his confidence. Mention has been made above of three valuable donations which he made in the cause of science; but there is good reason to believe that these are only a small fraction of the contributions he made to scientific objects.

For months it has been known that Sir Arthur could never recover and he has been withdrawn from his most intimate friends; but the passing of one who has had such an influence on the lives of individuals, on the progress of science in his own country and on the attempt to attain international co-operation in scientific matters cannot but come as a shock, and there will be many in all parts of the world who will feel a personal loss in the death of Sir Arthur Schuster. G. C. S.

Mr. George Fletcher

THE many friends of Mr. George Fletcher will have received the news of his death on September 20 with deep regret and a sense of personal loss. While an electrical engineer on the old Midland Railway, he studied at the Derby Technical School, and soon made his mark as a lecturer of exceptional ability. His success as an organiser attracted the attention of Sir William Abney and led to his appointment in 1894 as inspector under the Science and Art Department. He worked for two years in the west of England and was then put in charge of the Midland Division, comprising many important schools. As an inspector Fletcher was at his best and may be said to have established a new standard of inspection. His personal charm, wide knowledge of the aims and methods of practical studies, and his tendency always to help rather than to criticise, made him universally popular among teachers and colleagues.

On the establishment of the Department of Agriculture and Technical Instruction for Ireland, Fletcher was appointed by Sir Horace Plunkett in 1901 as Chief Inspector, and on Sir Robert Blair's appointment to the post of Education Officer to the London County Council, he succeeded him in the post of Assistant Secretary, Technical Instruction, to the Department. In this capacity he did much to foster the growth of a public sense of responsibility for education, and the local committees under his sympathetic guidance became responsible and progressive bodies.

The recent wide extension of the administrative and rating powers of local committees have been rendered possible by Fletcher's patient work during the past twenty-five years. His many-sided interests made him a constant contributor to educational discussion at international conferences, and at meetings of the British Association.

News and Views

Prof. L. J. Henderson

THE cost of the new University Library at Cambridge, which is to be opened by the King on October 22, was defrayed, in part, from a munificent benefaction given by the Rockefeller Foundation; the rest of that benefaction having been devoted to the development of biological science. It is appropriate, therefore, that the University should utilise the occasion to confer the honorary degree of Sc.D. on two biologists from the United States, Dr. Lawrence J. Henderson, professor of biological chemistry at Harvard University, and Dr. K. Landsteiner, of the Rockefeller Institute for Medical Research. Dr. Henderson comes of that old New England stock from which so much of the flower of Harvard has grown. He graduated at that University in 1898 and has held his present chair since 1919. It is difficult to-day to imagine that at the commencement of the present century, there were no exact ideas about the 'reaction' of biological fluids and that the sign '*p*H' did not exist. To-day, hydrogen ion concentration is regarded as one of the most fundamental conditions which govern the reactions of the body. Henderson had a great hand in this revolution, and especially in the investigation of the balance between carbonic acid and base, by which the hydrogen ion concentration of the body is maintained so close to neutrality. The famous 'Henderson-Hasselbalch equation' stands like a monumental stone testifying to the part which Henderson played. After the War, Henderson concerned himself with a more comprehensive study of the equilibria occurring in blood. The investigation of these centred principally about three groups of factors: (1) the properties of hæmoglobin; (2) the composition of the plasma; and (3) the nature of the membrane which separates one from the other.

IT had been recognised that in the simultaneous presence of oxygen and carbonic acid, the equilibria which hæmoglobin forms with each gas is not independent of the other. Henderson showed, however, the existence of an equilibrium to which eight factors contributed: oxygen, carbonic acid, water, chlorides, serum proteins, serum bases and intracellular bases and hæmoglobin. If the concentration

of any two is altered to a known degree, the whole equilibrium involving the other six could be calculated. These relations he expressed in the form of nomograms in his book "Blood" which appeared in 1928. As the concentrations of the above factors in the blood are largely governed by its surroundings, Henderson's mind was much concerned with the general topic of 'environment', to which subject he made a contribution of great importance in his book "The Fitness of the Environment" (1913). Lastly, Henderson himself appreciated that the blood does not spend long enough in any one set of surroundings for the complete establishment of the equilibria appropriate to them ; it is upon this subject that he is giving a short course of lectures on October 16, 17 and 18 at University College, London, and on October 19, 23 and 24 in the Physiological Laboratory, Cambridge.

Tribute to Prof. E. G. Coker

THE retirement of Prof. E. G. Coker from the Kennedy chair of civil and mechanical engineering in University College, London, was the subject of a couple of paragraphs in the News and Views columns of NATURE of August 11. Opportunity was then taken to refer to a few outstanding points in Prof. Coker's career and work, particularly his researches on the use of polarised light in determining the distribution of stress in machines and structures. On October 11, a complimentary dinner was given to Prof. Coker at University College, London, and he was presented with a cine-camera and a cheque by past and present colleagues and students. Lord Rutherford, who presided over a large assembly representing various departments of university teaching and research, recalled the days when Prof. Coker was associate professor of civil engineering in McGill University, Montreal, and he himself was Macdonald professor of physics in the same University. Since then Prof. Coker's pioneer work has been recognised by his election as a fellow of the Royal Society, and by the use of his results in solving many scientific and engineering problems. Prof. L. N. G. Filon, who collaborated with Prof. Coker in the production of the exhaustive treatise on photo-elasticity, published in 1932, added his tribute to that of Lord Rutherford. In his reply, Prof. Coker said that the council of the College has permitted him to take away much of the apparatus which he used in his researches, and that he proposes to continue his work in a laboratory which he has constructed near his home.

Thomas Henry, F.R.S. (1734–1816)

THOMAS HENRY, the senior member of that family of chemists whose exploits won for them no mean place in the history of the science, was born at Wrexham on October 26, 1734. On leaving the local grammar school, he was apprenticed to an apothecary at Wrexham, but completed his initial training at Knutsford, and afterwards became chief assistant to a Mr. Malbon at Oxford. In 1759 he returned to Knutsford, and in 1764 established himself as an apothecary in Manchester, where he continued in practice for almost half a century. Notwithstanding his extensive practice, he was an ardent experimentalist and ambitious to extend the boundaries of chemical science. His numerous publications testify to his wide interests and his unremitting labour, "An Improved Method of Preparing Magnesia Alba", "Experiments on the Influence of Fixed Air on Vegetation", "Experiments on Ferments and Fermentation", and "The Nature of Wool, Silk, and Cotton as Objects of the Art of Dyeing" being a selection of the papers he communicated to learned societies. To-day his name is, perhaps, chiefly associated with "Henry's Calcined Magnesia", a preparation patented by him which is still on the market. Henry was elected a fellow of the Royal Society in 1775 on the recommendation of his friends Sir John Pringle, Joseph Priestley, and Benjamin Franklin. On the foundation of the Manchester Literary and Philosophical Society in 1781, he was elected one of the secretaries, and was the president from 1807 until his death in 1816. He was a keen educationist, and gave lectures in Manchester on chemistry and on bleaching, dyeing, and calico printing. Henry was essentially a practical man. He saw the need for the application of chemical knowledge to the arts and crafts, and in attempting to meet that need did much towards paving the way for the union of pure and applied chemistry.

Chemistry in Industry

BRITISH chemical industry has in recent years been the subject of political discussion, of Governmental action, and of no little anxiety among those who realise the effect which duties, quotas, restrictions, and the like may have for better or for worse on a great national enterprise which has scarcely reached adolescence. In a world of such complex economics, the necessity of an organisation whereby exchange of views and corporate action are facilitated becomes at once apparent, and it is therefore not surprising that the Association of British Chemical Manufacturers finds its activities and its responsibilities increasing year by year. In moving the adoption of the Council's report at the annual general meeting of the Association, held on October 11, the chairman, Mr. F. H. Carr, referred at some length to its activities, its extending influence, and its increasing membership. There has been an unusually heavy loss by death of leaders in the industry ; reference was specially made to the late Sir Max Muspratt, a founder and a wise counsellor who played a great part in the development of British chemical industry and contributed in no small degree to the strength and reputation of the Association. By the service of Sir Max Muspratt and many men of like character and attainments, and by the devotion of the staff, the Association to-day finds itself able to protect the interests of British chemical manufacturers to a degree undreamed of when it was first formed. Its membership roll now includes no fewer than one hundred and eleven firms, and other applications are pending.

EXHIBITIONS and fairs are always a source of concern to firms which have to consider how far the results attained justify substantial expense. The Association of British Chemical Manufacturers, not unmindful of the fact that the key industry duties on fine chemicals will, unless removed, expire in 1936, urges manufacturers to exhibit at the forthcoming British Industries Fair in order to show the general public and those in authority how great and wise a use has already been made of that protection. Recent trade statistics show a marked increase in the importation of chemical products which are made in Great Britain; chemical exports have also increased, but to a smaller extent. Doubtless there is ground for investigation whether the best use is being made of our tariff system, for further attention by manufacturers to the necessity of endeavouring constantly to increase the attractiveness of their products in the world's markets, and for greater consideration by buyers of the claims, *ceteris paribus*, of home manufactures. The Ottawa agreements have benefited the chemical industry in many directions, although certain unexpected difficulties have arisen. Mr. Carr warned his audience that if the Ottawa idea is to be continued and expanded, there is an urgent need for the economic planning of agriculture and of industry in the Empire. Consideration has lately been given also to the position of the chemical and allied industries in relation to Government-owned patents, and a scheme of co-operation with the Department of Scientific and Industrial Research and the British Chemical Plant Manufacturers' Association has been evolved. Other sections of the report or of the chairman's address referred to safety measures, transport, poisons rules, the fine chemical industry, and the dyestuffs industry.

The Government Laboratory

REPORTING on the work of the Government Laboratory for the year ended March 31, 1934 (London: H.M. Stationery Office, 1934. 9*d*. net), the Government Chemist, Sir Robert Robertson, refers *inter alia* to the frequent necessity for investigating work in connexion with chemical tests on imported goods and articles of commerce. He briefly summarises the results of tests applied to dairy products, and once again mentions that there is no standard, as regards fat content, for cream in Great Britain, and no regulations relating to the marking of skimmed or partially skimmed milk cheese. A curious incrustation on the surface of stored marine shells was found to consist of calcium acetate. The shells had been stored in drawers of oakwood, which is known to evolve traces of acetic acid continuously, and the effect was attributed to the localised action of acetic acid attracted by the deliquescent residue from sea-water salts. Among the great variety of duties performed by the Laboratory during the year, in addition to numerous analyses of foods, drugs, fertilisers, water, beverages, dyes, oils, silk, etc., were the restoration of medals and plaques for the Imperial War Museum, detection of the fraudulent use of stamps, a search for the cause of earthy flavour in fish, complete analyses of rocks for the Geological Survey, the recovery of radium from decayed luminous paint, and the examination of materials purchased for the public service.

Whale-Marking in South Georgia

IN view of the complete lack of accurate knowledge on the migrations of whales, the "Discovery" Committee has for the past nine years been conducting experiments in whale-marking. The only practicable method of marking is by shooting a mark into the blubber from a gun. In the first series of experiments the mark used consisted of a barbed pin attached to a disc designed to lie flush with the surface of the body. Numbers of whales were marked by this means, but no marks were returned from those engaged in the whaling industry. At the Marine Biological Station in South Georgia it was found that *Pennella*, a parasitic copepod which infects whales in temperate and sub-tropical regions, was rapidly extruded from the blubber when the whales visited the cold waters of the Antarctic, and since this parasite is very firmly anchored in its host, it is practically certain that the whale marks were extruded in the same way. Another pattern of mark was devised—a short length of stainless steel tubing fitted with a leaden head. This mark is designed to embed itself completely in the blubber; when once the wound of entry has healed, the mark cannot fall out, and it will be found without difficulty by the whalers when the blubber is stripped from the carcase. Experiments conducted with this pattern give promise of success: five of the marks used have been recovered, three after the lapse of a few weeks and two after thirteen months. In no case was there any sign of suppuration, and in some the wound could not be found. All the whales were in good condition. The Committee is now undertaking whale-marking on a larger scale. One of its scientific staff, Mr. A. H. Laurie, left England in September to carry out the work in South Georgia, and on October 16 the R.R.S. *William Scoresby* left for the whaling grounds off Bouvet Island and Enderby Land on a whale-marking cruise. Mr. G. W. Rayner, who has conducted many of the earlier experiments, is scientific officer in charge, with Lieutenant C. R. U. Boothby in executive command.

National Trust's New Property in Derbyshire

BY the generous gift of Mr. F. A. Holmes of Buxton, announced on October 10, Stanton Moor Edge, near Rowsley, Derbyshire, becomes the property of the National Trust. This body is already the owner of three properties in the immediate neighbourhood, Shining Cliff Woodlands at Ambergate, Duffield Castle and Taddington Wood. The new acquisition consists of 28 acres and is an escarpment, 900 ft. above sea-level, which forms a natural terrace a mile in length, looking out over moorland and the valleys of the Wye and Derwent. Not only is the view from this escarpment of great natural beauty, but it is situated in the middle of an area of exceptional interest for the historian and archæo-

logist. It has been a centre of human habitation from the stone age onward and is one of the principal centres in Great Britain of the civilisation of the early bronze age, when it appears to have been thickly populated. In addition to the evidence of stone circles, round barrows and other monuments in the area, the culture of the district is to be studied in the rich and varied collections of funerary pottery, implements, weapons and ornaments of stone and bronze, which are to be seen in the museums of Buxton, Derby and Sheffield. Mr. Holmes, in addition to this generous gift, has shown his interest in the preservation of the antiquities and natural beauties of his county by his association with the efforts which secured the other Derbyshire properties for the nation, as well as by his work as chairman of the Buxton Committee of the Council for the Preservation of Rural England.

Stenhouse Williams Memorial Library

ON Saturday, October 13, the library erected at the National Institute for Research in Dairying (University of Reading), to the memory of the first director of the Institute, Dr. R. Stenhouse Williams, was opened by the Minister of Health, the Right Hon. Sir E. Hilton Young, in the presence of numerous guests, presided over by the chairman of the Board of the Institute, the Earl of Iveagh, and including subscribers to the memorial fund, members of the University of Reading, and others directly interested in dairy science or the Institute. Sir Hilton Young said that it was particularly gratifying to him as H.M. Minister of Health to assist in celebrating this step forward in the development of one of the most essential health services. Milk has a unique place in the dietary of the people, and although its consumption is relatively low, there has been in recent years an increasing understanding by the public of the value of milk in nutrition. He emphasised the importance of research in increasing the consumption of milk and improving the methods of production, and paid a tribute to the great pioneering activities of Dr. Stenhouse Williams in the field of dairy research, and in the development of the Institute. A library is an absolutely essential part of the Institute. Its foundation is, however, but a beginning : it needs not only the original but also the continued benevolence of the community. All present would remember with gratitude those who have combined to bring this memorial into existence in so appropriate and so efficient a form, and particularly they would think of the man who would continue to be an inspiration to those who came after him. It was stated that the Library building has cost approximately £3,000 and that present contributions to the memorial fund amount to £2,300.

The Maison de la Chimie in Paris

THE opening of the Maison de la Chimie on October 20 in Paris marks the completion of the first step towards a comprehensive scheme of centralisation of chemical bibliography and other scientific activities. The Maison de la Chimie had its origin in the celebration of the centenary of Marcelin Berthelot in 1927, when a sum of twenty-five million francs was collected by international subscription. The French Government presented a historic building—the house of La Rochefoucauld—d'Estissac, rue St. Dominique, near the Chamber of Deputies. This has been reconstructed and extended to house a library equipped with the latest facilities. Large halls for meetings of scientific societies and congresses have also been provided. Indeed, this is a special feature of the project, and the opening of the building by M. Lebrun, President of the Republic, is to be followed by the holding therein of the fourteenth Congress of Industrial Chemistry (October 21–27). M. Jean Gerard, administrator of the Maison de la Chimie and Secretary of the International Union of Pure and Applied Chemistry, hopes to develop the present centre into a "Maison de la Science" where international congresses in all scientific fields can meet and be assured of the services of a staff accustomed to the organisation of congresses. All those who have attended international gatherings know that the standard of efficiency with which they are run varies considerably, and that a little more attention paid to the purely technical part of their organisation would often add considerably to their scientific value. We may therefore wish M. Gerard all the success that his plans deserve.

Iraq Oil reaches Haifa

THE construction of the Iraq Petroleum Company's pipe-line to convey oil from the Mosul oilfields to the Mediterranean seaboard is an engineering feat of no mean importance and one which has been watched with keen interest by petroleum technologists and engineers all over the world. Its real completion may be said to have been achieved at 2.30 a.m. on October 14, when the first stream of oil pumped from the fields reached Haifa ; according to the *Times* it is anticipated that the first shipments of oil will be made before the end of October. The pipe-line stretches for nearly 1,200 miles over extremely difficult country, much of which is desert. It runs from Kirkuk to Haditha, where it bifurcates, and the southern (British) line follows through Transjordania and reaches the pipe-line terminal at Haifa. The actual pipe-line was completed in 1933, since when most of the engineering work has been concerned with the installation of the necessary boosting stations *en route*. With the delivery of oil to the seaboard, it may be confidently asserted that the pumping installations have proved their efficiency and that the regular flow of oil will now become a routine matter. We have as yet no information as to whether oil is being diverted along the French line, that is, through Syrian territory to Tripolis, but doubtless this will also soon be an accomplished feat. The influence of this oil now made available to European refineries will be considerable, and will undoubtedly affect both the political and economic aspects of the petroleum industry within a comparatively short space of time.

Scientific Meetings and the Public

MR. T. SHEPPARD, director of the Municipal Museums, Hull, contributes to the October issue of the *Naturalist* some notes on points of interest connected with the recent meeting of the British Association at Aberdeen. In a paragraph on "Lectures and Lecturers" he says, "We have complained over and over again of the apparent inability of many of the lecturers to give audible and understandable discourse"; and he refers to the plea made at the meeting by Mr. H. T. Tizard, and on many other occasions, for increased care by scientific workers in speech and writing. Unfortunately, some authors of papers seem to be unaware of the most elementary principles of speaking to an audience. If they read their papers, they speak to the desk with their heads down, and if they use blackboards or diagrams they turn their backs to the assembly. While research is being carried on into the conditions of good acoustics in buildings, and architects are criticised for not taking these conditions into consideration, many scientific men would apparently not trouble to make themselves heard in the most perfectly designed building; and even when a microphone is provided they turn away from it. In a communication to a scientific society, inability to speak with ease is perhaps pardonable when an investigator is presenting the results of original research to other workers in the same field. The British Association, however, "seeks to promote general interest in science and its applications". No technical qualification is required for membership, and every year the public is invited to join and attend the meeting. There are thus particular reasons why speakers in the section rooms or elsewhere should remember the character of the assembly they are addressing. Whatever the nature of the audience, however, if an author is not prepared to take the trouble to make himself audible and intelligible, he should not be permitted to irritate his hearers and his paper should be 'taken as read'.

Science and Social Reconstruction

IN the eighth Steinmetz Memorial Lecture delivered before the Schenectady Section of the American Institute of Electrical Engineers on January 10, Dr. C. E. Kenneth Mees, under the title "Scientific Thought and Social Reconstruction", endeavoured to assess the contribution which men of science can make to the solution of our social and economic problems. While the lag between a scientific discovery and its application tends to decrease and consequently the rate of change produced by scientific knowledge to increase, he does not think that the rate of change will continue to increase. It is highly probable that our social system is in an unstable phase, but after a period of rapid change in which the state of strain is relieved, it should settle into a new and stable phase. While admitting that the man of science must be actively concerned with the vast social and political experiments of our time, Dr. Mees does not consider it would be wise for him to take up the burdens of the politician. He believes that the chief contribution of science to social reconstruction is the method and spirit in which the scientific worker approaches his own work of creating ordered knowledge which is then available for all.

THE transformation of technical industry in the last twenty years is due as much to the growth of the scientific spirit in all sections of the industrial organisation as to the actual laboratory work, and a like transformation in government is required. The use of the scientific spirit in Government would be effectively promoted by scientific men expounding insistently the nature of scientific thought and studying its application to our social and political problems. Discussing the part played by emotion in politics and the opposition between science and arbitrary authority, Dr. Mees insisted on the necessity for some appreciation on the part of men of science of the impossibility of leaders of a democracy being entirely scientific in their attitude. The transformation of industry already indicates the possibility of orderly evolution, and problems of social reconstruction could ultimately be dealt with in the same way as other problems, if men of science set themselves continuously to assist in the wise selection of leaders and in the education of the community as to the meaning of the scientific method and spirit.

Vocational Guidance and Juvenile Employment

THE National Advisory Councils for Juvenile Employment have issued a joint report on the organisation and development of the vocational guidance services in Great Britain (H.M. Stationery Office). The report gives the history of the national scheme for advising boys and girls on the choice of employment. The first attempt on a national basis dates from the Labour Exchanges Act of 1910, when special provision was made for young applicants. It is estimated that probably one in every four of the total number of engagements of juvenile staff is effected through the official organisations of the local committees for juvenile employment. The methods by which advice is given on industrial and kindred matters fall into two divisions—collective and individual. The former includes lectures, visits to factories, display of films and slides on industrial subjects. Individual advice is given to more than a quarter of a million boys and girls, so that roughly rather more than one in three receive expert advice before entering upon initial employment.

THE basis of all sound vocational advice is the alliance of the teachers' knowledge of the individual juvenile's educational and personal capacity with the industrial knowledge of the juvenile committees. The hope is expressed that there should be a reconsideration of the form of the school-leaving report so as to make it more adequate. Finally, in this connexion there is a survey of the experimental work in industrial psychology as an aid to vocational guidance. The principal published experiments are given in an appendix, and consideration of the claims made leads the authors of the report to the conclusion that "the application of psychological methods to

vocational guidance should still be regarded as at the experimental stage" though "sufficiently encouraging to justify the continuance of experiments". It is therefore recommended that the Industrial Health Research Board in co-operation with the Ministry of Labour should carry out further experiment. Various suggestions are made for the co-ordinating of existent services and for a better interchange of information between the various bodies concerned.

Present and Past World Problems

DR. NICHOLAS MURRAY BUTLER has been protesting, in an address delivered at Columbia University's summer session convocation on August 7, against the absurdity of treating the world problems of our time as if they were unprecedented—as if there had been no tests in the past of theories and ideals of social, economic and political life as applied to conditions fundamentally similar. Between 1776 and 1789, the thirteen American States faced every single problem which the nations of the world face to-day. What those sovereign States were doing then, indulging in internecine tariff wars, boycotts, export prohibitions, pandering to short-sighted prejudices and particularist passion, the sovereign nations of the world are doing now. The substantial identity of the problems and of the futile tactics with which it was sought to circumvent them are illustrated by passages quoted from the works of F. S. Oliver and John Fiske and from State papers. It was Alexander Hamilton who, combining an acute intelligence, assiduous study, varied experience, indomitable courage, tenacity of purpose, persuasive eloquence and whole-hearted devotion to ideals, saved the States from the ruin towards which they were drifting, and it is by the application of the spirit of his policies to the needs of the nations of the world to-day that these may yet be saved from the world chaos with which we are threatened. The title of the address is "The World needs another Alexander Hamilton".

Work of the Meteorological Office

THE annual report of the Director of the Meteorological Office for the year ended March 31, 1934 (London: H.M. Stationery Office. 1*s*. net) is on the same general lines as previous reports, but is somewhat longer, numbering sixty pages; this expansion has its counterpart in an all-round increase in the activities of most of the different sections of the Office, in particular as regards the number of persons or institutions that were supplied with meteorological information, particulars of which are given in the report. In one respect, however, this report differs from those of recent years; it is made more self-contained by a modification of the introductory matter into a fairly detailed exposition of the normal work of the Meteorological Office, especially that part of it connected with synoptic meteorology which involves the collection of data broadcast by foreign countries and by ships at sea, and the supply of such data for the British Isles and neighbouring seas in return; little or no knowledge of such matters is assumed on the part of the reader. The statistics relating to the work performed in response to external demands for information show in some cases a striking rate of increase; for example, the forecast service dealt with 10,166 inquiries for the Press compared with 8,705 in the previous year, an advance that cannot wholly be explained by the abnormal weather of 1933–34, although this was doubtless partly responsible for it. In the section concerned with British climatology, where inquiries about past weather, some of which are of a very detailed character, are dealt with, the number of such inquiries was 2,222, and it is stated that in comparison with the annual figure ten years back, this represents a six-fold increase. The report not only summarises the activities of the branches of the Office at headquarters, located in Kingsway, London, and at Exhibition Road, South Kensington, but also those of the observatories and of the branches in Scotland, Malta, Egypt and Iraq.

Co-operation between Aeronautics and Meteorology

AN interesting case of co-operation between scientific workers to their mutual advantage is revealed in the annual report of the Meteorological Office. The Royal Air Force has established a meteorological flight at Duxford Aerodrome, Cambridge, which consists of two aeroplanes with the necessary pilots and ground staff. Their particular duty is to collect information regarding the upper air, and flights are made daily to heights of 25,000–30,000 feet. These flights often involve penetrating cloud layers several thousands of feet thick, and such is the keenness of the station personnel that more than 90 per cent of the scheduled flights have been completed during the past year. Information developed from this is prepared specially for civil flying and distributed from such centres as Croydon. The report states "The rapid growth of flying in and above clouds on the Continental air routes, and the practice of following a direct compass course between the terminal aerodromes, have necessitated the forecasting of much more critical conditions than formerly. Consequently the work at Croydon has become highly specialised and necessitates forecasters of considerable experience of the peculiarities of these air routes, which—in the opinion of pilots of wide experience—are the most difficult from a meteorological point of view of any in the world". 336 gale warnings were issued during the year, of which 81 per cent were justified. It has also been established that there is a fair measure of agreement between the frequency of thunderstorms and the occurrence of sunspots in high northern and tropical latitudes, though not so marked in the temperate zones.

Biological Field Station near Sydney

THE Sydney University Biological Society has recently opened a field research station at Narrabeen, the erection and fitting of which was accomplished at a very modest cost by members of the Society and of the Sydney University Rover Scouts; the building

(*Continued on page* 623.)

Supplement to NATURE

No. 3390 OCTOBER 20, 1934

Reviews

A Monument of Lexicography

Webster's New International Dictionary of the English Language. Second edition, unabridged. Pp. xcvi+3210. (London: G. Bell and Sons, Ltd.; Springfield, Mass.: G. and C. Merriam Co., 1934.) 84*s.* net; with Thumb Index, 90*s.* net; 2 vols., 85*s.* net; with Thumb Index, 90*s.* net.

THE appearance of the long-anticipated second edition of "Webster's New International Dictionary" is an event of considerable and pleasurable importance. "Webster" is *sui generis* —inimitable in conception and unexcelled in achievement—and has won, on its merits alone, a place of pre-eminence in a world by no means ill-provided with dictionaries of high rank. Comparisons, we know, are odious, but since the thought of the great "Oxford English Dictionary" must be present in every English-speaking mind as that of the supreme exemplar of lexicography, it is necessary to inquire at once into the relation between that majestic work and the "New International Dictionary". A very practical difference lies in the disparity of prices, for, even in the form of its cheaper reprint, the O.E.D. is beyond the pocket of the average man, while "Webster" costs no more than a weatherproof. A second utilitarian difference is in the disparity of sizes, for while even the smallest study or office could accommodate "Webster" (which might indeed stand permanently on the corner of a desk), the O.E.D. spreads itself luxuriantly over several feet of shelf-room. We do not, of course, quarrel with either bulk or price when the former is so worthily filled and the latter so fairly set as in the O.E.D.; but when we buy a dictionary they are considerations of immediate concern.

It is, however, not in corporeal or financial respects that the crux of the contrast lies. The O.E.D., if we may so put it, is a dictionary primarily for the scholar, while "Webster", though thoroughly deserving the epithet of 'scholarly', is designed for the educated, practical citizen of the world; it is, in fact, considerably more than a dictionary and approaches the character of a vast encyclopædia in miniature. To take an example in point: if we have occasion to look up the word 'book binding' it is scarcely likely to be for the purpose of discovering the meaning of the term, and "Webster" intelligently anticipates the probable reason by giving a concise table of the principal bookbinding styles, with their dates, their characteristics, and particulars of the persons by, or after whom, they were named. In the same way, under the word 'coin', we find not only the etymology and meanings of the word, but also a lengthy list of the principal current coins, with their equivalents in (*a*) other native coins, (*b*) U.S. currency and (*c*) British currency; while a double-page coloured plate of some seventy or eighty coins forms an admirable complement to the text of the entry.

A typical example of the treatment of a scientific word is to be found under 'chlorine', where, after the pronunciation and etymology of the name, the chief chemical properties, physical constants and uses of the gas are succinctly mentioned. Important scientific topics are given the dignity of a column or more: thus 'element' has nearly two columns (including a list of the elements with their symbols, atomic numbers and atomic weights); 'fruit' has nearly a column, with a scheme of classification of fruits and a chart of the more important varieties; 'colour' has three columns with two coloured plates; and if 'palmistry' has a longer entry than 'physics' the occasion is merely one for congratulation on the part of the palmist, not for complaint on the part of the physicist. The latter, indeed, will discover that he has been provided for with noteworthy efficiency—photon and proton, neutron and positron, quantum and millicurie, and a thousand physical terms, are defined with a precision that leaves nothing to be desired. Other branches of science are accorded the same comprehensive and intelligent attention, with a success that must make "Webster" an indispensable companion to the scientific worker.

In its more general aspects, the dictionary is equally comprehensive, accurate and concisely informative. Much as we may regret them, for example, there are numerous slang words and phrases the meanings of which we find it necessary to know; and if they are of any wide circulation,

"Webster" will almost certainly be found to have included them. There are, however, a few curious omissions in this respect, for while "sex appeal" is decorously defined, "glad eye" is unaccountably absent, and though "kick the bucket" is equated to "to die" there is no mention of "conk out". These omissions, we may readily agree, are more than balanced by the welcome inclusion of such good English dialect words as "dither" and "nesh", "drang" and "toot" (in the sense of a small hill).

The pronunciation of words is clearly indicated, and, in many cases, where the American pronunciation differs from the English, both are given—for example, under 'schedule' (skĕd′ul and shĕd′ūl)—though occasionally the American form only is noted. The etymology is scholarly and conservative, and in those test instances that we have applied to it (for example, Whitsuntide, pea, grobel) has always been correct.

Among the remaining features of the dictionary are a biographical section of more than 13,500 names of noteworthy persons (sufficiently up to date to include Herr Hitler), a pronouncing world gazetteer of some 30,000 places, a table of forms of address, a very useful section on arbitrary signs and symbols, a lengthy list of abbreviations in common use, plates of national flags, a history of the English language, modestly described as brief, and a guide to pronunciation. The book is profusely and appositely illustrated, and many of the principal words are provided with antonyms and synonyms. It would, indeed, be difficult to suggest any improvement, even in detail, and the editorial board, printers and publishers are to be unreservedly congratulated on the production of a superb example of lexicography. They have placed the whole of the English-speaking world under a lasting debt to them ; and they should feel happy in the thought that "Webster", re-invigorated and reinforced, has once more undertaken its task of universal service. The dictionary-maker is no longer 'a harmless drudge' ; he is a vital factor in the advance of learning and the progress of civilisation.

E. J. Holmyard.

British Neolithic Man

The Skeleton of British Neolithic Man : including a Comparison with that of other Prehistoric Periods and more Modern Times. By Dr. John Cameron. Pp. 272+16 plates. (London : Williams and Norgate, Ltd., 1934.) 15*s.* net.

THIS book is clearly the result of long and careful work by Dr. Cameron. It is a digest, more or less complete, of the state of our knowledge of prehistoric man compared with that of the man of historic times, down to the present day. It is not, I think, a book meant for the general reader, nor would it mean much to him ; but to the serious worker in anthropology, who is able to distinguish its strong from its weak points, it will be very valuable, and it is sure of a place in every scientific library.

The amount of original work which the author has put into it is not very large, and with what there is I cannot always agree. The new theories to account for platymeria and platycnemia, for example, would be all the better for discussion and criticism at the Anatomical Society, where they would have to run the gauntlet of men who are handling bones, and the muscles which mould them, every day.

All the standard indices, angles and arcs are dealt with, one by one, and those of the Neolithic people are contrasted with those of other races which have inhabited, or are inhabiting, Great Britain ; but what the author has not done—possibly because he assumed that his reader knew it already—is to point out that if all these are put together, they will not produce average pictures of the skulls of the different peoples examined ; indeed they often produce skulls so grotesque that even a layman would laugh at them.

I am very grateful to Dr. Cameron for his kindly mention of so much of my work but I would exchange it all for a passing reference to the average skull contours, derived from series of horizontal and vertical measurements of dioptographic tracings, published in "Early Man" by the Royal Anthropological Institute. A glance at these would show how completely Mr. Macdonell was misled by thirteen indices into stating that the seventeenth century Londoner was a Neolithic man ; for the modern Londoner's contour has been worked out and may be placed side by side with that of the Neolithic people, and it does not need an anatomist to see how utterly different they are.

Then again, it is a pity that Dr. Cameron chose the Hythe skulls as types of medieval Englishmen, for they differ from all our other medieval skulls, at Rothwell, Dover and Upchurch, in being those of a settlement of round-headed people who must have come into England from the Continent in the thirteenth or fourteenth century, and resemble the Mid-European type very closely. The typically English collection from Rothwell would have served his purpose so much better.

I have given the book this serious criticism because I think that it is worth it, but I must not forget to add that perhaps the part which will be most useful of all is the list of ancient skulls in the different museums of Great Britain ; for which, I gather, we have largely to thank Miss Tyldesley.

F. G. Parsons.

The Folk-Play

The English Folk-Play. By Sir E. K. Chambers. Pp. vii+248+2 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 10*s.* net.

DURING the last thirty years, considerable attention has been given to the English folk-play. When in 1903 Sir Edmund Chambers attempted an account of the 'mummers' play' in his book "The Medieval Stage" only twenty-nine examples were available: in the present work he has drawn upon well over one hundred and there may be, he thinks, others which have eluded his search. This form of rustic entertainment had, in fact, almost died out, when it was revived as a result of antiquarian research.

From many points of view, the English mummers' play merits attention, especially now that it is possible to appreciate that it is not an isolated phenomenon, but may well be one manifestation only of a folk-drama which can be traced back with some show of probability to a fundamental religious conception once wide-spread among European peoples.

In essence, the structure of the English folk-play is uniform, wherever recorded. From the various versions available, Sir Edmund Chambers has reconstructed a norm. It cannot, it is true, be regarded as representing the archetype, which probably is not now recoverable; but it does serve to help in restoring the form, and at times the text, of corrupt versions. The play opens with the entrance of a presenter, the personage who announces the principal characters in turn as they enter, each then making a self-descriptive speech. The principal characters, St. George, the 'antagonist' and the Turkish knight, or Capt. Slasher, the 'agonist', then fight and the latter is slain. A doctor appears who, after a certain amount of fooling and rough word-play with his assistant, brings the dead man to life again, and the play ends with the *quête*, which may become something in the nature of an afterplay, in the style of a revue, with a miscellaneous collection of characters and little or no connexion with the main plot.

The author gives a detailed account of the variations of the form, personages and text of the play, which, apart from its main purpose, affords a revealing insight into the peculiar working of the English rustic mind. Changes due to the desire to be topical are frequent. Hence the appearance among the characters of personages now historical, such as Napoleon, or a suffragette "with clogs on my shoulder". Sometimes the presenter is Father Christmas, and the agonist—a point of importance for the history of the play—the dragon slain by St. George. Learning by oral transmission is responsible for numerous textual variations, many puzzling and some amusing. "Rantantorious" for "Pandora's box" is not the least striking.

It is curious and instructive to find that an apparently purely rustic production is not free from the influence of the legitimate drama—a point which should be noted by students of the folk-tale in debating the question of literary sources. Congreve's "Love for Love", for example, is one of several plays that are cited. This contact is to be traced to itinerant players. Nor does extraneous influence appear in matters of detail alone. Sir Edmund derives the traditional antagonist and agonist, St. George and the dragon—when there is a dragon—from the sixteenth century vogue of St. George which found expression in Richard Johnson's "Famous Historie of the Seven Champions of Christendom" of 1596. Before that date, there is clear evidence for only one drama in which St. George appears. This was at Lydd in 1456.

In considering the question of origin, it might be thought that if it has been shown that the traditional centre of interest, the combat between St. George and the dragon or the dragon's substitute, has been traced to a sixteenth century literary origin, the problem is solved. This, however, is not the case, for it does not account for the several elements of the play, such as the woman, the fool, the doctor and his cure, and the most remarkable and pivotal incident, the revival from death. These belong to a remoter antiquity.

The clue lies in the seasonal character of the plays. They were performed at Christmas and, exceptionally, at Easter and the beginning of November, at All Souls. In Lincolnshire and Nottinghamshire, where the killing is loosely associated with a wooing melodrama, the plays belong to Plough Monday at the beginning of January, the day on which agricultural operations are resumed ceremonially after the rest period of Christmas. This seasonal association brings the plays within the category of the seasonal observances and festivals of Europe celebrating the death of the old year and the birth of the new year—the ancient European fertility drama of which the various forms have been described and analysed by Sir James Frazer in "The Golden Bough". The nearest parallel to the English mummers' play is recorded in the Balkans and Greece; but here the fertility motif, which, except in the presence of the woman and possibly in the buffoonery and jesting of the fool, has disappeared from the English form, is preserved in the presence of the phallus and the obscene actions of certain male and female characters.

An interesting point is raised in connexion with

the plough-plays. As has been mentioned, in these the 'killing' is loosely connected with a 'wooing' drama in which one or more suitors seek the hand of the woman. Sometimes there is no killing. Sir Edmund suggests that here we may see the merging into one of two separate classes of drama. The form occurs, it is to be noted, in an area of marginal distribution of the normal mummers' play, where indeed there also appears a connexion with the sword dance, the seasonal festival performance which in the north of England takes the place of the mummers' play. It would be of interest to inquire whether there is any evidence that the 'wooing' is a development of that sexual side of the original rite which has dropped entirely out of the mummers' play. Many of the seasonal festivals, such as the traditional Games of Ireland, and the agricultural festivals of China—perhaps a far cry—preserved this tradition by being the recognised occasion of betrothal and marriage.

The interest of the broader issues raised by this study of the folk-play must not be allowed to obscure its excellence as a record and a study of what the folk-play is or has been as a form of popular art. Both from this aspect and as an examination of the facts pertinent to its ritual origin, Sir Edmund Chambers' book is likely to stand as final.

History of Wheat in Great Britain

Wheat in Great Britain. By Dr. John Percival. Pp. 125+63 plates. (Reading: The Author, Leighton, Shinfield, 1934.) 10*s.* 6*d.*

PROF. PERCIVAL has long been known as an able student of wheat, and an assiduous collector of its different varieties. He has not been content with obtaining ears as herbarium specimens, but has grown them so that he could study their habits of growth and compare them when placed under similar conditions. The work was at first arduous and discouraging: an older generation of Wye College students remembers him rising at 4 a.m. on summer mornings to keep the sparrows off his ripening corn. But he continued undaunted, and as a result has produced in succession sets of a remarkably extensive collection of wheat varieties suitable for colleges, a monograph which has now become the standard one on the subject, and this book which, though small in size, is packed with interesting information and is very fully illustrated.

Prof. Percival has always been able to present a subject well, and he uses this gift to great advantage in the present book. Starting from the earliest finds of wheat in Britain, grains apparently of a primitive type of *Triticum vulgare* found at Hembury Fort, Devon, in 1931, which seem to be definitely of Neolithic Age and dating back perhaps to 2000 B.C., he reviews in succession the later finds: grains resembling emmer (*Triticum dicoccum*) found in an early Bronze Age barrow, and a primitive form resembling *T. Spelta* found at Meare, the late Iron Age settlement in Somerset dating from about 150 B.C. So he goes on right through to modern times, telling us on the way a great deal that is interesting about the history of bread and of milling.

An important section of the book deals with the cultivation of wheat and the effects of climate and other conditions on its growth. Good use is made of the Rothamsted data on the subject, which are now very extensive. The methods of improving wheat are given in sufficient detail for most purposes, and the results are set out at greater length. Finally, there comes an account of the wheat varieties that are or have been grown in the British Isles. Here we miss a few that have figured in the history of agricultural science: Old Red Lanmas, the first variety to come under scientific experiment in Great Britain, being used on Broadbalk presumably because it was a standard sort on the wheat lands of Hertfordshire in the 1830's; Red Cluster, that followed it for a time, and Red Rostock, which was retained all through the palmy days of the 1850's, '60's and '70's. But these have long passed away and all the important kinds grown now or in living memory are here.

Altogether the book can be strongly commended to botanical and agricultural students as a compact summary of much information that they will not easily obtain elsewhere. E. J. RUSSELL.

Quantitative Plant Ecology

The Life Forms of Plants and Statistical Plant Geography: being the Collected Papers of C. Raunkiaer. Pp. xvi+632+53 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 35*s.* net.

A GREAT deal of the literature of ecology is of a purely descriptive character, and it is not perhaps too much to say that many accounts of plant communities which are published to-day, if they add something to our information, add little to our knowledge. Such descriptions are too often the mere multiplication of examples, the working out of the same ideas upon other material without any enlargement of the philosophical concepts involved. Not the least of the debts which we owe to the Danish school of plant geographers and ecologists is that they have not been content to be merely imitators, but have extended the boundaries of our knowledge. In

particular, we owe to Warming and Raunkiaer the recognition of the importance of autecological studies of which biology stands in such need to-day. But to Raunkiaer we also owe the application of exact quantitative methods to the analysis of vegetation and the statistical treatment of plant communities. The translation of Raunkiaer's works into English is therefore particularly welcome, since the original papers written in Danish have only been known to many workers from summaries.

Raunkiaer's name is chiefly associated with the concept of the biological spectrum representing the percentage frequencies of the various types of adaptation to an unfavourable season present in the flora of any area, whether it be a geographical region or the sample of a plant community. Raunkiaer was able to demonstrate that different climatic regions are characterised by different biological spectra, the arctic, for example, being the region of chamæphytic vegetation, the north temperate region that of the hemicryptophytes, the tropics the region of trees and shrubs, whilst deserts are characterised by the high proportion of therophytes.

The quantitative analysis of plant communities forms the subject of the papers presented in Chaps. vi and ix of the work under review. The value of the author's biological classification is illustrated by the study of the vegetation of newly developed soil, of that of the arctic and antarctic, and of that of the Mediterranean region. But, whether the conditions of the environment be edaphically or climatically distinct, Raunkiaer was able to demonstrate that the 'biological spectrum' was correlated with the climatic complex which the meteorological and soil conditions combine to produce. Other aspects of Raunkiaer's wide interests are represented by the chapters dealing with the ecology of *Tussilago farfara*, the influence of types of vegetation on soil acidity, and the nitrate content of *Anemone nemorosa*. The value of Raunkiaer's emphasis on the necessity for quantitative data in the study of plant geography and ecology cannot be easily overestimated, and this is still true even if we doubt whether some of its particular applications have as much value as he attributed to them.

It is much to be regretted that the followers and imitators of Prof. Raunkiaer have frequently been too perfunctory in the application of the principles which he laid down. Too often it would appear that the categories of the life forms of species have been copied by one author from another without their applicability to the region concerned having been definitely ascertained. The variability of species in this respect is indeed an important indication of the 'plant climate' which such perfunctory studies may completely obscure. If, for example, the status of *Scrophularia vernalis*, cited by Raunkiaer (p. 44) as a proto-hemicryptophyte be true for Denmark, this is of considerable interest, since in Britain *S. vernalis* is a biennial rosette plant. The statement on the following page that *Rubus chamæmorus* is without stolons is clearly an error, and not an example of different behaviour. The fallacy in assuming the constancy of life form for any given species was demonstrated by Raunkiaer himself in his study of *Tussilago*, whilst striking examples have also been furnished by Warming, Allorge and others. Such plasticity should emphasise the value of the study of the biology of individual species and serve as a warning against the formal application of systems of biological classification.

The determination of the life form of a species often involves careful and continuous research, but Raunkiaer in his endeavour to construct a simple system, easily applied, perhaps himself encouraged its formal application. Whilst he divides the phanerophytes into fifteen sub-types of very varying biological significance, no distinction is drawn between winter-green semi-rosette species such as *Anthriscus sylvestris* and summer-green types such as *Laserpitium*. Although frankly recognising the distinction between winter annuals and summer annuals, Raunkiaer nevertheless has one class of therophytes only. Such inequalities in his biological groupings and the fact that for the establishment of the concept of the biological spectrum Raunkiaer was forced to utilise rather inadequate data, possibly led to the view that the determination of the life form was quite easy. Actually, as the reviewer has elsewhere shown, even so simple a matter as whether a species is annual or perennial may only be determinable with considerable difficulty.

Ecologists generally will feel a debt of gratitude to the translators, Dr. H. Gilbert-Carter, Prof. A. G. Tansley and Miss Fausboll, who have rendered the works of Raunkiaer available in English, and to the Danish committee which conceived the plan of their publication and financed the undertaking.

E. J. S.

Pastoral Poisons

The Toxicology of Plants in South Africa : together with a Consideration of Poisonous Foodstuffs and Fungi. By Dr. Douw G. Steyn. (South African Agricultural Series, Vol. 13.) Pp. xii+631. (Johannesburg : Central News Agency, Ltd. ; London : Gordon and Gotch, Ltd., 1934.) 47*s.* 6*d.*

IN England, losses of farm animals through the ingestion of poisonous plants in pastures is so infrequent that when it does occur it is apt to

figure as 'news' and to evoke in the Press a gentle stream of correspondence, pleasantly reminiscent, usually interesting and sometimes useful, though not always distinguished by accuracy in technical details. In countries less fortunate in this respect, of which South Africa, Australia and parts of the United States are examples, losses due to the poisoning of stock are a much more serious matter. In general, only cases involving large numbers of animals are reported, so that accurate figures for total losses in any country are not obtainable, but Dr. Steyn quotes an impressive list of examples. Thus, one plant alone, *Geigeria passerinoides*, took toll of more than a million sheep in Griqualand West and the south-eastern portion of south-west Africa in 1929–30.

The Union of South Africa is one of the few countries in which this subject is being systematically investigated and this book, as its title implies, is one result of the experience gained in the course of the work done by the author as head of the Department of Pharmacology at the Onderstepoort Laboratories in the Transvaal. The book falls naturally into two main sections. The first 73 pages deal with the general toxicology of plants, starting with the early history of the 'art of poisoning' as practised in Greece and Rome, leading up to a thoroughly practical discussion of all the chemical, pharmacological and administrative problems involved in answering the apparently simple questions: Is such and such a plant poisonous, and if so what should be done about it? Dr. Steyn and his colleagues have now answered these questions for a considerable number of South African plants, and the answers, with the data on which they are formulated, are given in the second and larger portion of the book (pp. 74–607).

It is already clear that these plants are divisible into four groups containing as their toxic constituents oxalates, cyanogenetic glucosides or possibly other sources of prussic acid, fluorescent substances causing photosensitisation in animals and specific poisons respectively (cf. NATURE, **133**, 972, June 30, 1934). The last-mentioned group shows a tendency to sub-divide generically; species of *Senecio* or ragworts, for example, are liver poisons and, so far as they have been chemically examined, owe their activity to specific alkaloids; the species of *Geigeria* produce 'vermeersiekte' (vomiting sickness), but nothing is yet known as to the nature of the poisonous constituent. On the other hand, substances with a digitalis-like action are more catholic in their distribution and are to be found in genera of both Apocynaceæ and Liliaceæ. The number of plants for which the phrase 'active principle unknown' has to be recorded is still large and, in this direction alone, the South African workers are not likely to lack occupation for some time to come.

The arrangement of matter in this section is botanical and the information supplied under the name of each plant is full and usefully critical. Numerous illustrations are provided and references to all the significant literature are given in an excellent bibliography. As the Right Hon. J. C. Smuts says of the book in his foreword, "It represents years of research work at the Onderstepoort Laboratories and in the field, and forms without a doubt the most authoritative treatise yet written on this important subject". This, as becomes a statesman, is an expression of the practical value of the book to the pastoralist, his scientific advisers and those whose duty it is to deal with the administrative problems involved. The book is, however, also a valuable stimulant to work on biochemical problems, such as the significance of the widespread occurrence of cyanogenetic products in plants, and the extent of variation in a particular type of constituent throughout a genus of plants, to which comparatively little attention has so far been given. T. A. H.

The Quantum Theory

Wave Mechanics: Advanced General Theory. By Prof. J. Frenkel. (International Series of Monographs on Physics.) Pp. viii+526. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 35*s*. net.

THIS work belongs to the international series of physical monographs that is being issued by the Oxford University Press. Prof. J. Frenkel is responsible for three volumes on the quantum theory. The first, entitled "Elementary Theory", came out two years ago, and was very briefly noticed in Nature of June 17, 1933, p. 860. This is the second, entitled "Advanced General Theory", and the third dealing with certain special problems, such as molecules and collisions, is promised for the future.

The first book of the Oxford series was Dirac's famous work on the quantum theory, and there could be no contrast more complete than that between it and the present books. In Dirac's book the theory is presented in a clear, rather abstract and perfectly orderly manner, no loose ends are seen, the logic is inescapable, and after reading it one cannot see why we were all so stupid as only to have understood the quantum a few years ago. Of course, reflexion shows that it is not really so simple after all, but that is the impression left by the lucid exposition and the extraordinarily powerful and deep symbolism. Here the whole approach is different; it is inductive rather than

deductive, and one may regard the whole work as a commentary on Dirac's, for the use of those who do not take kindly to the deep symbolism. The author aims at making everything physically natural by marshalling all the various arguments, analogies and illustrations together, explaining how they lead to the right results, and pointing out the errors and fallacies of other arguments that would lead the wrong way.

When the late Lord Rayleigh had constructed one of those wonderful instruments out of cardboard and sealing-wax with which he was able to produce results of the highest standard, he used to describe the instrument's not very impressive appearance by saying that it "looked as if somebody had made it himself". This is a book that looks as if somebody had written it himself. To read a chapter is to be led by the hand through all the struggles of the kind that one would have to face alone if one were trying to master an unfamiliar subject out of a rather abbreviated encyclopædia article. Without the help, one would spend much time doing the wrong thing and finding out why it was wrong, wondering why some indirect method was used instead of a frontal attack, not seeing the need for some simplifying assumption, and overlooking the importance of some little qualifying phrase. The present work will spare the reader all such troubles, for he is taken through all the difficulties in detail and everything that can go wrong is explained, as well as everything that does go right.

The work has some of the defects of its merits also, for it reads rather like an incomplete piece of original research ; as it goes along, one is never quite sure what has been proved and what only made plausible, and what were the premises from which the argument started. For these reasons, it is to be doubted if this second volume is suitable for an introduction to the subject (though the same is not true of the earlier one) ; the beginner does not want to read a long account explaining away some difficulty of which he is quite unaware, but on the other hand the same student will later find the book a very valuable commentary when he has got hold of the principles from other sources.

Of the two volumes, the first, of 280 pages, was developed almost entirely on the lines of the pure wave theory, and gave an admirable survey from that point of view. Its arrangement was a great improvement on that in some earlier books ; for example, such things as free motion and the passage of potential walls came before the structure of atoms. It traversed all the ordinary branches of the theory, and in the later parts gave a good account of a subject that can scarcely be called elementary, the so-called double quantisation. The new volume is a much more formidable affair, consisting as it does of more than 500 pages. Though it takes wave theory as its basis, it works mainly on the lines of operators and matrices, and it is perhaps not so good as the first, since it applies the same discursive method of detailed physical presentation, whereas in a second volume something more formal and deductive would have been appropriate. It takes one right back to the start in explaining the connexion of the method of operators and matrices with that of waves, whereas it would give a juster view of the relationship to present the operational method merely as a more powerful technique for dealing with matters of which the physical basis had already been expounded.

With this proviso, it will be found that the book gives a very full account of the essentials of the quantum theory. The progress is slow, and it perhaps makes unduly heavy weather of the mathematical technique, for, after all, no one who is not a fairly accomplished mathematician is competent to embark on such a detailed study of the quantum theory. It begins with classical theory and some discussion of waves and then in turn passes to operators, matrices, transformation theory, perturbations and the spinning electron. It then goes on to the problem of many particles, discusses in detail the difficult theory that is needed for such topics as ferromagnetism, and concludes with a review of the present unsatisfactory state of radiation theory. Altogether, anyone who is puzzled about any general point in the quantum theory will almost certainly find it explained somewhere, and indeed twice over, once in each volume, so that he can take it with whichever flavouring he prefers.

The two books illustrate a difficulty in the presentation of the quantum theory that will have to be gradually worked out ; and this is the question of what previous knowledge should reasonably be assumed in the student. For example, in Frenkel's first volume on p. 9 there stands unexplained the formula for the relativistic line element, whereas on p. 28 there is a rather detailed discussion of the ordinary group velocity of waves. There may of course be some difference in education in England and the U.S.S.R., but it seems a curious inversion of the order in which one would expect the student to learn mechanics. Sooner or later there will have to be an accepted body of fore-knowledge for the quantum theory, just as there is for such things as the theory of electricity. It is, of course, easiest to say that the student should know all about waves, all about electricity, all about relativity, all about the transformation theory of classical dynamics, all

about matrices and all about groups. Such a student would certainly be well equipped for his purpose, but it is to be doubted if he would still be a student by the time he was ready to begin. For the physicist, the main interest of some of these things is their bearing on the quantum theory, and so a knowledge of them should certainly not be assumed in advance.

There will be a fairly general agreement among authors about most of these subjects. Thus, though it must be admitted that algebra has been much neglected in the general mathematical courses in Great Britain, it would be out of place to assume any knowledge of matrices, and the same is true of group theory. On the other hand, it is natural to take for granted a considerable knowledge of waves, of classical electrical theory and optics, and some elementary knowledge of relativity. The most interesting question is how far the student should be taken in classical dynamics before beginning quantum theory; in particular, how much attention must be given to transformation theory. Ten years ago, everyone was deeply immersed in Poisson brackets, angle variables and such things, so that it was then natural to emphasise their analogies in the quantum mechanics. It is more questionable how far it is worth doing this now, for the new transformation theory is really simpler and far more important; and so it may not prove worth while to familiarise the student in advance with the classical transformation theory, since its chief interest is merely to show the analogy with something that ought itself to be still more familiar. These questions must be a matter of consideration to anyone making a presentation of the quantum theory, and no doubt with the lapse of time a fairly definite level of fore-knowledge will settle itself.

The reading of any book or paper on the quantum theory cannot but excite criticism of the slovenliness with which English equivalents have been chosen for certain foreign terms. There is not much harm in the actual use of a foreign word, at any rate until the associated idea has become entirely familiar; thus to borrow *austausch* unchanged does no harm, but only implies that the borrower was ignorant and too lazy to get a dictionary. It is when a purely German grammatical construction is literally translated that the result becomes intolerable. The adjective 'wave-mechanical' may perhaps just pass muster among those who are not very squeamish about their grammar, but such a horror as 'quantumtheoretical' (either as one or two words or hyphenated) really will not do. However much one may believe in exploiting to the full the flexibility of the language, this word surely strains it beyond the elastic limit, and, though we all dislike novelties, the proper way of finding the necessary contrast to the word 'classical' in English is to coin some such word as 'quantical'. These reflexions have been provoked by a general study of the literature and not specially by the present books. Prof. Frenkel has a very fine mastery of the English idiom, and has been well helped in his composition, so that it is only rarely that one comes across anything which even hints that he was not writing in his native language.

C. G. D.

Modern Electromagnetic Theory

Electromagnetism. By Prof. Hector Munro Macdonald. Pp. xv+178. (London: G. Bell and Sons, Ltd., 1934.) 12*s.* 6*d.* net.

PROF. MACDONALD'S work apparently has grown out of his Adams prize essay on electric waves published more than thirty years ago and is certainly one of the most striking books on electromagnetic theory published within recent years. Its scheme is based on the laws of Ampère and Faraday together with Fresnel's law of transversality; and it leads to the result that "the electromagnetic field outside any closed surface, due to a distribution of matter inside, is determined completely when the components of the electric and magnetic forces tangential to the surface are known, but a knowledge of the external magnetic field is not sufficient to determine the electric and magnetic current distributions inside it". It follows that the external effect of the inside matter can be represented by electric and magnetic currents over the surface.

As in his essay on electric waves, so here, the author uses Maxwell's expression for the magnetic part of the electromagnetic energy in terms of the electric current and electrokinetic momentum instead of the more usual one in terms of the magnetic force and induction, and he deduces an expression for the flux of energy, which differs materially from the Poynting flux, being expressed in terms of the magnetic force and electrokinetic momentum. The author points out that both give the same total change in the amount of energy inside a surface in a time which is a multiple of all the periods involved, so that periodic disturbances cannot decide between the two views. It would be interesting if an expression could be deduced for the rate of radiation of energy from an electric charge moving with given velocity and acceleration for comparison with Liénard's well-known formula.

The book is divided into eight chapters, of which the first two are devoted to the general theory of propagation of electric effects in free space and material media, and the third and fourth to the transmission of waves in transparent and

conducting media. The fifth treats of electric currents in a conducting sphere with and without an external magnetic field, and the sixth, which is the longest in the book, gives a very full discussion of diffraction and scattering with special reference to the nature of the disturbance near the edge of the shadow and in the neighbourhood of caustics. The seventh and eighth deal with radiation and resonance and material systems in motion.

Quite apart from the frequently novel methods employed, the book is a very useful compendium of recent work on electromagnetism. It is well printed and produced and is commendably free from misprints, considering the often complicated character of the formulæ employed.

Tannin Chemistry

The Natural Organic Tannins : History, Chemistry, Distribution. By Dr. M. Nierenstein. Pp. vii + 319. (London : J. and A. Churchill, 1934.) 21*s*.

THE historical studies of Dr. Nierenstein, who is an authority on the history of the tannins, must be of interest to all workers on the chemistry of tannins and of leather. To read how closely Tachenius in 1677 foreshadowed recent work on the rotting of ink-dyed leather is a valuable reminder of the length of time which elapses between suggestion and proof in this branch of chemistry.

In dealing with the organic chemistry of the tannins, Dr. Nierenstein gives a useful description of existing knowledge, somewhat obscured by a detailed account of the controversies between the rival schools of Nierenstein and of Fischer and Freudenberg. It is doubtful whether the differences at issue in the catechin group are of sufficient importance to require detailed description in a general treatise. The discussion of the constitution of the gallotannins, however, makes it clear that some of the conclusions of the German school must be regarded with doubt, yet, as Dr. Nierenstein himself points out, his suggested formula for glucosidic gallotannin is not far removed from formulæ which Freudenberg admits as possibilities. It is not easy to reject the larger volume of evidence that glucose is an essential part of the gallotannin molecule on the grounds of the few reported observations of the occurrence of the tannin free from glucose. References to "the glucose spectre, haunting the chemistry . . . of gallotannin" and to the glucoside hypothesis as a "stumbling block" are unduly strongly worded.

From the practical point of view of the tanner, the significant difference between the two classes of tannins is that the pyrogallol tans contain more ionisable hydrogen atoms and therefore have a more acid reaction than the catechol tans. Variations between the action of different tans of the same class are to a large extent due to differences in the size of the tannin particles in solution. The physical chemistry of the tannins requires as much attention as has been devoted to their organic chemistry. Perhaps in future editions Dr. Nierenstein, and other writers on the chemistry of the tannins, will give some account of information which is already available on this aspect of the subject.

The botanical section, written by Dr. MacGregor Skene, collects the existing knowledge of the distribution, behaviour and functions of tannin in the plant. This useful summary contains some interesting suggestions. If the catechol tannins are related to the anthocyanins, and play a part in metabolism, while the gallotannins are excretory products, it is an attractive speculation that the initial by-products of metabolism are rendered harmless by combination with glucose. Perhaps 'glucose siren' would be a more appropriate expression than 'glucose spectre'. The charmer is too seductive to be dismissed lightly, and the time has not yet come when we must stop our ears, in spite of the Ulyssean warnings of Dr. Nierenstein.

D. JORDAN LLOYD.

Evolution of Ideas of Space

The Differential Invariants of Generalised Spaces. By Prof. Tracy Yerkes Thomas. Pp. x+241. (Cambridge : At the University Press, 1934.) 21*s*. net.

THE subject of this book is extremely difficult for the general scientific reader. Even what seem to be familiar words, such as *space* and *parallel*, are used in such generalised senses that they become more puzzling than entirely new terms. This is the result of a process of evolution, and can be understood only by recalling the history of these ideas.

For the Greeks, the rigid body was fundamental, and space was mere emptiness containing it. Geometry expressed the properties of rigid bodies such as measuring rods, including the properties of congruence, established by superposition. Thus geometry was primarily a physical science, but it was reduced to a deductive form, based on a small number of axioms which, with the exception of that relating to parallels, could plausibly be regarded as self-evident truths. The idea of space as consisting of points was reached

about two thousand years later, from the analytical geometry of Descartes (1637). In Newton's laws of motion (1686) space was considered a physical reality. Henceforth the term really bore two different meanings, one mathematical and one physical, but the distinction did not become clear until the great mathematical and physical advances of the nineteenth century. *Ether* (according to Einstein) is merely the name given by Faraday and Maxwell to space regarded as the seat of electromagnetic phenomena. On the mathematical side, the long-continued efforts to prove Euclid's parallel-axiom led to the discovery by Lobachevski (1829) and Riemann (1854) that perfectly logical systems of geometry could be devised in which the parallel-axiom was denied. The term non-Euclidean was introduced by Gauss. Space and geometry were no longer unique, for they could be based on any self-consistent set of postulates. However, this aspect did not receive much attention until the work of Pasch, Peano, Hilbert and others, at about the beginning of the present century.

When it was realised that the co-ordinates of Descartes were not restricted to Euclidean space, there remained no reason for restricting the number of dimensions to three. Cayley (1843) and Grassmann (1844) dealt with analytical geometry of N dimensions. In 1859 Cayley put forward his theory of the *absolute*, which was later developed by Klein, whose Erlangen programme (1872) had a far-reaching effect. Klein considered certain groups of transformations by which a set of points are permuted among themselves. To every such group corresponds a particular kind of geometry. For example, to the *affine* group (the group of all linear transformations) corresponds affine geometry, including the plane geometry defined by such of Euclid's axioms as do not refer to congruence. But wide as was Klein's scheme, it still required extension. So early as 1854, Riemann, in his famous dissertation "Hypotheses which lie at the Foundation of Geometry", had given a geometry of quite a different kind, in which the idea of length was fundamental. In this, the group concept failed. Contemporary geometers are now generalising the Erlangen programme, starting with the invariant which always exists, rather than the group from which the invariant may or may not have arisen. The idea of an invariant goes at least as far back as Gauss (1827), who considered the general problem of measurements on curved surfaces and obtained an expression for the curvature valid in any system of co-ordinates. This was the first example of a differential invariant. Further developments were due to Riemann (1861) and Christoffel (1869). The theory of tensors, so important in physics and geometry on account of their property of vanishing in every co-ordinate system if they vanish in one, was created by Ricci (1887) and his pupil Levi-Civita, although the name *tensor* was not introduced by them, but by Einstein (1916). Levi-Civita's concept of infinitesimal parallel displacements (1917) is of great importance, though his use of the word parallel is liable to be misunderstood. Weyl (1918) has contributed to both the mathematical and physical theories, which now, after a long separation, have come together again.

To many, the mathematical ideas of space seem important only as a quarry from which Einstein can obtain the stones to construct his physical theories. However, even from this narrow point of view, the quarrymen should be encouraged to extend their operations, since we do not yet know what kinds of stone will be most useful. The slow progress of the unified field theory seems to show that the present materials are not altogether suitable. The wider point of view is that the study of differential invariants is now pursued for its own sake, and the workers who are cultivating this field must not be hampered by the demand that they should look back and see how closely they are being followed. What started as geometry and developed as mathematical physics now exists in an abstract form independent of either, like the grin of Lewis Carroll's Cheshire cat when the cat itself had vanished.

Prof. Thomas gives an account of this abstract theory which is exclusively analytical, taking the invariant as fundamental, and pushing the geometrical or physical interpretation into the background. The earlier chapters deal with generalised spaces, invariants (including non-tensor invariants), and normal co-ordinates. Then there is a very full treatment of spatial identities, of which the best-known example expresses the conservation of energy in a gravitational field. This is followed by important chapters on equivalence and reducibility. The book concludes with a chapter on functional arbitrariness, and a rather meagre index. There are bibliographies at the end of each chapter.

The research worker who needs an account of the latest advances (many due to Prof. Thomas himself) will find the book of great value. On the other hand, the ordinary student may find it difficult. Those to whom the subject is new should start with two Cambridge 'Tracts', Veblen's "Invariants of Quadratic Differential Forms" and Veblen and Whitehead's "Foundations of Differential Geometry", which explain the elementary ideas indispensable to an appreciation of the highly sophisticated modern developments.

H. T. H. Piaggio.

Short Notices

Anthropology and Ethnology

Habitat, Economy and Society : a Geographical Introduction to Ethnology. By Prof. C. Daryll Forde. Pp. xiv+500. (London : Methuen and Co., Ltd., 1934.) 15*s.* net.

Although the traditional evolutionary view of human society as a progression, which begins with food-gathering and ends with industrialism, does not now commonly occur in geographical and other textbooks in all its cruder simplicity, the various forms of human society are still often treated as if they could be classified in mutually exclusive types, each characterised by a single activity. Prof. Daryll Forde, by describing the life-histories and activities of peoples of primitive culture who, at least up to a few years ago, were untouched by Western civilisation, indicates the misleading trend of this conception. He demonstrates by concrete example the inherent complexity in even the most simple of societies, and the degree to which it is possible to maintain the traditional division of hunters, pastoralists, cultivators and the like.

The claims of description and classification in Prof. Forde's book, however, do not account for the whole of his story ; and it is in its broader aspects as an analysis of the development of culture that its greatest interest is to be found. In recognising the effect of, and assigning their appropriate function to environment, diffusion and economic and social factors, as a causation complex in the growth of culture, the author has made a valuable and substantive contribution to method and theory in anthropological studies.

Rebel Destiny : Among the Bush Negroes of Dutch Guiana. By Melville J. Herskovits and Frances S. Herskovits. (Whittlesey House Publication.) Pp. xvii+366+15 plates. (New York and London : McGraw-Hill Book Co., Inc., 1934.) 12*s.* 6*d.* net.

Dr. Herskovits, as students of current anthropological literature are aware, has been engaged for some time in studying the cultural status of the African Negro, with special reference to what is sometimes known in America as the Negro problem. With this objective he has worked in West Africa ; and has made a valuable study of the American Negro and the results of Negro crossing in the United States. In the course of his investigations, he has visited the communities of the Bush Negroes on the Suriname River in Dutch Guiana, which were formed after the rebellion of Negro slaves some hundred and fifty years ago. The members of these communities recreated something of their native African culture and this they have preserved in a modified but characteristic form ever since.

In the volume under notice, Dr. and Mrs. Herskovits give a popular and lively account of their contacts with these Bush Negroes. It is valuable as giving an insight into the mentality of a little-known people, and affords material for a comparison with the mentality and beliefs of the Negroes of the West Indies and the less advanced descendants of Negro slaves in the United States. The more strictly scientific account of the authors' results is to be published later.

Proceedings of the First International Congress of Prehistoric and Protohistoric Sciences, London, August 1–6, 1932. Pp. iv+322. (London : Oxford University Press, 1934.) 21*s.* net.

As it is unlikely that anyone seriously interested in the work of the First International Congress of Prehistoric and Protohistoric Sciences is unacquainted with the scope of its programme, it is unnecessary to do more here than note the appearance of the volume recording its proceedings. In addition to lists of officers, council and committees, the official report of the programme followed and other administrative and historical detail, it gives abstracts of the papers, which not only serve as a record of the communications submitted, but are also sufficiently full, so that, although not complete, each will serve as a locus of reference.

Biology

The Dinosaurs : a Short History of a Great Group of Extinct Reptiles. By Dr. W. E. Swinton. Pp. xii+233+25 plates. (London : Thomas Murby and Co., 1934.) 15*s.* net.

Of all extinct animals, the land reptiles named Dinosaurs are the most widely familiar and most frequently mentioned. The gigantic and bizarre proportions of many of them appeal to the popular imagination, and they often lend themselves to effective use in humorous pictures. Dr. Swinton has therefore done good service by writing and publishing an authentic account of our present knowledge of these animals, to which easy reference can be made. He has treated the subject from every point of view, and the attractiveness of his book is much enhanced by several beautiful photographs of new restorations of Dinosaurs made under his direction by Mr. Vernon Edwards.

After some preliminary chapters, in which there are interesting hypothetical maps of the world during the three long periods when Dinosaurs flourished, the various groups are described and discussed in systematic order. The account is remarkably exhaustive and well up to date. For the naturalist, it furnishes an admirable compendium which cannot be found elsewhere ; for the general reader it will prove more difficult on account of the frequent use of technical terms and expressions, although some of these are explained in the glossary at the end.

In one of the final chapters, Dr. Swinton remarks on the rarity of traces of disease in the bones of Dinosaurs ; and in another chapter he discusses the possible causes of the complete extinction of the

group at the end of the Cretaceous period, without reaching any more definite conclusion than previous observers have done. He has also some interesting notes on the methods of collecting and preparing Dinosaurian fossils, and he concludes with a useful alphabetical list of those which have been found in Britain. Lists of the literature of the subject throughout the book make it a valuable work of reference for those engaged in research. A. S. W.

The Great Design: Order and Progress in Nature. Edited by Frances Mason. Pp. 324. (London: Gerald Duckworth and Co., Ltd., 1934.) 8*s.* 6*d.* net.

THE aim of this work is to show the plain man that the world, as we know it, is shot through and through by pattern and law, and that this implies the existence of a supreme designer and law-maker, the basis of religious faith. Its method is to bring together a series of essays, each written by an expert, in which departments of science are discussed from a modern point of view in order to bring out the prevalence of order and its implications.

The result is less satisfactory as a unified body of opinion than the editor's earlier "Creation by Evolution": there is a good deal of overlapping, for example, in the repetition of the story of radiation, protons, electrons, and so on; and there are frequent contradictions, as when the geologist takes the continents and ocean basins to be, on the whole, permanent features, while the zoologist assumes the occurrence of continental drift to explain the migrations of eels and of birds, or when the zoologist postulates for the origin of life an act of creation, while the botanist states that protoplasm was originally evolved from non-living matter. Moreover, the compression of some of the essays makes the conclusions seem far removed from the facts on which they are based, so that they must appear to a non-scientific reader as little more than a series of dogmas.

The book, however, gives simple summaries of the position of science in many fields, and the reader cannot but be impressed by the number of scientific workers who find, each in his own field, that the discoveries of science afford a rational basis on which faith may rely. There is no necessary contradiction between science and religion. J. R.

Bumblebees and their Ways. By Prof. Otto Emil Plath. Pp. xvi+201+11 plates. (New York: The Macmillan Co., 1934.) 17*s.* net.

THIS book is based upon first-hand observations carried out during thirteen consecutive seasons on the bumble bees known to inhabit New England and other parts of North America. The author is evidently an ardent and skilled field observer, and has produced a very readable and interesting natural history study. Bumble bees have not hitherto received very much attention from the biological point of view in America, although an excellent taxonomic guide is available in Franklin's "Bombidae of the New World". Dr. Plath has already written a number of papers on bumble bees in various North American periodicals and, while the substance of this work has been incorporated in the pr sent volume, the greater part of its contents consists, he tells us, of material not hitherto published.

The book is divided into thirteen chapters dealing with different phases in the life of these insects. The author has been very successful in adopting means of rearing bumble bees in artificial nests, and describes his methods. By this means, in conjunction with his field work, he has been able to add to what is known concerning their habits. Among the new results of his studies, mention needs to be made of the evident 'behaviouristic' differences that he brings to light among different species. These observations form the basis of his classification of the species into groups—a feature which has been a long-standing difficulty.

At the end of the book there is a useful synopsis of the common American Bombidæ, with their distribution and habits, followed by an adequate bibliography. We note that the names *Bremus* and Bremidæ are withdrawn by Dr. Platz, and trust that there will not be occasion for their revival.

A. D. I.

An Introduction to the Vertebrates. By Prof. Leverett Allen Adams. Pp. v+414. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 21*s.* 6*d.* net.

THIS is a useful and, for its bulk and within the limits the author set himself, a very comprehensive work. A slight formal description of the classificatory characters of the vertebrate groups and subdivisions is followed by more detailed discussion of the organic systems of each class, based for the most part upon selected types. The third and most important section of the book contains comparative accounts of the various anatomical systems and of specialised structures. Descriptions are concise and to the point, illustrations are abundant and clear, and the schematic diagrams, for example, of the blood circulation, give an easily grasped picture of progressive changes. Our one complaint, a minor one, is that in the pictures which illustrate the preliminary classification, no indication of reduction is given, so that a meadow-lark looks as large as its neighbour, a penguin, and a *Tarsius* larger than a hippopotamus. J. R.

Economic Mammalogy. By Junius Henderson and Elberta L. Craig. Pp. x+397. (London: Baillière, Tindall and Cox, 1932.) 26*s.*

MANY readers outside the ranks of zoologists will study this book with interest and profit, for in easy style it discourses upon almost every conceivable way in which mammals come in contact with mankind for good or ill. Its speciality, apart from the interest of its classification of mammalian economics, is statistics, and the figures, whether of meat consumption, of the slaughter of fur-bearing animals, of damage done to crops and stocks, and so on, are up-to-date and astounding. The general discussion

is followed by a résumé of the economic interests of each mammalian order and, in the case of the more important orders, of their families. It is only fair to add that the authors have almost entirely ignored literature published beyond America, but the field is enormous, and they have done their part well. J. R.

Life in the Making. By A. F. Guttmacher. Pp. 288. (London: Jarrolds Publishers (London) Ltd., 1934.) 10*s.* 6*d.* net.

Mr. Guttmacher gives a statement in non-technical language of the present state of knowledge of the physiology and genetics of reproduction, with special reference to man. The origin of the life of the individual in the fusion of the sperm and the egg, the rôle of sex hormones, the determination of sex, factors affecting fertility and the cause and characteristics of like and unlike twins are treated in a scientific setting, but with an absence of technical terms unknown to the ordinary educated reader. In each section of the subject, the growth of knowledge is traced from the earliest known myths and superstitions to the present day. The book is eminently suitable for the reader who wishes to get a general scientific knowledge of reproductive phenomena in man.

Chemistry

Organic Chemistry: or Chemistry of the Carbon Compounds. By Victor von Richter. Edited by Prof. Richard Anschütz and Dr. Fritz Reindel. Vol. 1: *Chemistry of the Aliphatic Series.* Newly translated and revised from the 12th German edition (after the translation of the 2nd English edition by Dr. Percy E. Spielmann) by Eric Newmarch Allott. Pp. xiv+790. (London: Kegan Paul and Co., Ltd.; Philadelphia: P. Blakiston's Son and Co., 1934.) 35*s.* net.

Richter's manual has been available in English over a long period of years, and the need for successive editions is a sufficient indication of the esteem in which it is held by students and teachers. A valuable feature of the latest edition is the replacement of references to the *Centralblatt* by those to the originals from 1910 onwards, some additional references being included. The character of the book is too well known to require explanation. It is essentially a descriptive account of compounds, the theory being kept to a minimum. The brief statements of preparations and properties, with numerical data, make it a valuable work of reference, but the large amount of ground covered makes it hard reading for students.

The printing is excellent, the structural formulæ being very clearly set out, and as an account of the general chemistry of aliphatic compounds in a reasonable space the book is without rival. It should be found in every chemical library; and everyone interested in organic chemistry, even incidentally, will find it useful. The literature appears to have been well covered up to quite recent papers, and the amount of information given is impressive.

The Fundamentals of Chemical Thermodynamics. By Dr. J. A. V. Butler. Part 2: *Thermodynamical Functions and their Applications.* Pp. x+271. (London: Macmillan and Co., Ltd., 1934.) 8*s.* 6*d.*

Dr. Butler's second volume gives a simple and readable account of the more modern aspects of thermodynamics on the lines of the activity concept. Experimental data are given, with clearly drawn curves, to illustrate the applications of the methods, and there are some problems and exercises. In some parts, the treatment seems too restricted and liable to create a false impression; for example, only a few lines are given to the extensions of the theory of Debye and Hückel by La Mer, Gronwall and Sandved, whilst it is well known that the simple theory fails in nearly all cases which have been adequately examined; Fig. 12, whilst showing "excellent agreement", as the author says, is superseded by more modern work which is not mentioned. Although the book cannot be said to provide an adequate critical discussion of the modern aspects of experimental thermodynamics, it deals in an able manner with the theory, and may be recommended to students as an introduction to more detailed treatises.

Physico-Chemical Practical Exercises. By Prof. William Norman Rae and Prof. Joseph Reilly. Pp. xiv+276. (London: Methuen and Co., Ltd., 1934.) 7*s.* 6*d.* net.

The authors, whose massive treatise on physico-chemical methods is, or should be, part of the furniture of every well-equipped laboratory, have now provided a handy and inexpensive volume in which is described, succinctly and clearly, a series of standard exercises ranging from density determinations to measurements of ionic mobilities, electrolytic conductivities and hydrogen ion concentrations.

They give useful advice on methods of calculation and standardisation; something is said concerning nomograms, and we are glad to see that the long story of the calibration of a mercury-in-glass thermometer is omitted in favour of the more practical process of direct comparison with a thermometer possessing an N.P.L. certificate. A. F.

Geology

On the Mineralogy of Sedimentary Rocks: a Series of Essays and a Bibliography. By Prof. P. G. H. Boswell. Pp. ix+393. (London: Thomas Murby and Co., 1933.) 21*s.* net.

Prof. Boswell is well known as a leading authority on sedimentary petrology, a subject which has developed vigorously during the last two decades, largely as a result of his own researches. In this book, he summarises the literature and presents his own mature views on various aspects of sediments and their minerals, thereby making readily available to everyone interested in this branch of geology an authoritative and stimulating account of the present status of the subject and its significance.

More than half the book consists of a bibliography of 1,025 items, each accompanied by a brief but adequate abstract. The essays deal with such topics

as the history of investigation, detrital minerals, their assemblages, stability and application to problems of provenance and correlation, authigenic minerals, clay minerals and various individual types of sediment.

A very complete series of indexes adds greatly to the usefulness of the book. These make it easy to find every available reference to stratigraphical horizons, localities, minerals, figured minerals and technique. To students, the book is an unrivalled introduction to the subject; while to research workers in this field it is an indispensable aid to further progress.

The Determination of the Felspars in Thin Sections. By Dr. Karl Chudoba. Translated by Dr. W. Q. Kennedy. Pp. xii+62. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1933.) Cloth, 6*s*. 6*d*. net; paper, 4*s*. 6*d*. net.

THE felspars constitute by far the most abundant group of the rock-forming minerals, and their importance in petrographic description and classification is correspondingly high. A translation of Dr. Chudoba's little handbook on the determination of the felspars in thin sections of rocks is therefore particularly welcome. The problems involved are often difficult, but the author has succeeded in giving simple and accurate descriptions of methods which adequately meet most of the practical requirements. The diagrams and photomicrographs, numbering fifty in all, are clear and effective and embody useful summaries of the diagnostic optical properties. The translation has been very successfully carried out and will be highly appreciated by students and practising petrologists.

Mathematics

Elementary Calculus. By C. V. Durell and A. Robson. Vol. 1. Pp. viii+240. 4*s*. 6*d*. Vol. 2. Pp. xii+241–548. (London: G. Bell and Sons, Ltd., 1934.) With appendix, 7*s*. 6*d*.; without appendix, 6*s*. 6*d*.

THE authors of these volumes are among the teachers who are convinced that the youngest student of mathematics should be taught nothing which he will have to unlearn, and that unsound principles are not in fact easier to inculcate than sound ones. The references to Marlborough and Winchester in scholarship and tripos lists show that this theory of mathematical education works well in practice.

The first volume is strictly elementary both in range and in method: the only functions involved are rational and circular, about half the volume consists of unworked examples, and a considerable proportion of the exposition is conducted by means of worked examples. Perhaps the most interesting feature is the early introduction of differentials. The infinitesimal increments familiar in the nineteenth century were so dangerous that the differentials which were confused with them shared their banishment first from the university and then from the school. The true differential returned to Cambridge just after the War, and the current movement to welcome it back to more elementary class-rooms gains strong support from Mr. Durell and Mr. Robson.

The second volume is a continuation of the first. The structure is extended, on the foundations already laid. These foundations are sound, and of the multitude of students to whom familiarity with the processes of the calculus is a necessity, only a few need undertake a critical examination of them. Examples, worked and unworked, play the same part as in the first volume. The range includes the standard integrations, the commonest geometrical applications of the calculus, and an introduction to ordinary differential equations; the heading of approximations covers not only a statement of Taylor's theorem, but also an account of multiple points and asymptotes of plane curves which in spite of tradition certainly does not belong to a course on the calculus.

If a detail here or there invites criticism, this is not the place for it. The "Higher Certificate" ground has seldom been covered so admirably as in this careful and inspiring work, which fully maintains the authors' reputation. E. H. N.

Analytical Geometry. By Prof. V. Poor. Pp. v+244. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 13*s*. 6*d*. net.

DR. POOR'S treatment of analytical geometry is based upon the vector method. It embraces the conic sections in both two and three dimensions, and also some valuable matter on higher plane curves and curve fitting.

The theory connected with the ellipse and hyperbola is considerably shortened and elegantly dealt with generally by the introduction of λ for $a^2(1-e^2)$. Diameters, poles and polars are considered in a separate chapter, so that they may be omitted, if necessary, without loss of continuity.

The last four chapters are devoted to a concise discussion of solid analytical geometry, and an excellent plate is provided clearly illustrating the ellipsoid, the elliptic paraboloid and the hyperboloids. Adequate exercises are supplied which are not only well graded but are also designed to illustrate clearly the principles established in the text.

Miscellany

Faraday. By Thomas Martin. (Great Lives Series, No. 40.) Pp. 144. (London: Gerald Duckworth and Co., Ltd., 1934.) 2*s*. net.

THERE exists, nowadays, no lack of examples for those who would practise the difficult art of biography. At one end of the scale appears Hill's "Boswell", edited anew in six magnificent volumes, and still remaining, despite the new knowledge which has accrued to our generation, an enduring monument to Hill's genius as an editor. At the other end we have these florin biographies, wherein he who desires to discourse learnedly may gain his knowledge at the expense of an hour's reading. But, to invert a well-known *obiter dictum*, easy reading means condemned hard writing, and that author has his work cut out who would compress into a hundred and forty small octavo pages, a critical biography which shall tell

something of the man, something of his work, and shall descend to those pedestrian but necessary details of fact and date which your tendentious or psychological biographer is disposed to ignore.

A newly appointed provincial mayor once announced to his fellow-magistrates that it would be his constant endeavour to tread the narrow path which lies between right and wrong. Mr. Martin has had a different, but equally difficult path to tread, and he has succeeded where some of his predecessors must be held to have failed. He has limned for us a pleasant picture of Faraday's charming and simple personality; he has not been afraid to give us relevant dates and facts; and he has provided for that difficult fellow, the intelligent layman, apt to become confused between magneto-electrics and electro-magnetics, a statement of Faraday's contributions to science which is intelligible, interesting and accurate. What better investment can a cautious reader demand for his florin? A. F.

Empire Social Hygiene Year-Book 1934. Prepared by the British Social Hygiene Council, Inc. First Annual Edition. Pp. 509. (London: George Allen and Unwin, Ltd., 1934.) 15*s.* net.

THIS year-book constitutes the first comprehensive survey that has been made of the subject of social hygiene. The book has been largely compiled from material made available by various Government departments and health authorities concerned, and contains recent information on the incidence of venereal diseases and facilities for their treatment in towns and counties at home and throughout the Empire. Certain vital statistics, such as the death rate, infant mortality rate, death rate from tuberculosis, and number of mental defectives, together with some details of biological teaching in schools, for each area dealt with are also included. It is proposed that one Dominion, or group of Colonies, should be the subject of a special survey in each annual issue, and Canada is selected for this volume. Special articles and appendices conclude this useful Empire Year-Book.

Greek Geography. By E. H. Warmington. (The Library of Greek Thought.) Pp. xlviii+269. (London and Toronto: J. M. Dent and Sons, Ltd., 1934.) 5*s.* net.

As no early treatise on Greek geography has survived, the materials for re-constructing Greek notions of this subject have to be extracted from historical writers, or from later compendia of Roman date, such as Strabo and Pliny. This Mr. Warmington has done, giving English translations throughout, and grouping the passages under the main heads of cosmology, climatology, physical and political geography, exploration and mathematical geography with cartography. It was a pity to exclude writers so important as Xenophon and (in the main) Aristotle, though the difficulties of treatment are obvious. Necessary commentary is interpolated among the excerpts, or added in footnotes. There is a serviceable introduction and a good index.

The Book of Air and Water Wonders. By Ellison Hawks. Pp. 272+31 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 7*s.* 6*d.* net.

MR. HAWKS, the editor of the *Meccano Magazine*, has so many popular books on ships, machinery, astronomy and Nature, that we have lost count of them. They are most readable books, full of interesting sidelights and well illustrated. His latest book on the atmosphere, dew, fog, clouds, rain, wind, rivers, waterfalls and lakes, like his others, contains a lot of beautiful photographs, and from the armchair we are carried pleasantly to see Nature at work in many parts of the world.

Philosophy

Science and Sanity: an Introduction to Non-Aristotelian Systems and General Semantics. By Alfred Korzybski. (International Non-Aristotelian Library.) Pp. xx+798. (Lancaster, Pa.: The Science Press Printing Co., 1933.) 5.50 dollars.

BY analogy with a series of mathematical theories constructed on the negation of this or that axiom, Mr. Korzybski attempts to build up a non-Aristotelian system of universal knowledge. "Non-Aristotelian" is the name given to the system, because it purports to require the rejection of the famous principle of identity. This very foundation of the non-Aristotelian system seems very insecure to the present reviewer, for two reasons: in the first place, no one has consciously affirmed the principle of identity in the sense that Mr. Korzybski denies it; and secondly, this very principle is continuously, though covertly, used by the author, not only in the exposition of his views but also as identity of structure. The avalanche of irrelevant quotations from all fields of human knowledge does nothing but to add to the confusion in which one is left after reading this bulky volume. T. G.

The Horizons of Thought: a Study in the Dualities of Thinking. By Prof. G. P. Conger. Pp. xi+367. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1933.) 22*s.* 6*d.* net.

PROF. CONGER has a peculiar method of expounding his philosophy. He amasses a wealth of quotations or paraphrases which are, at least verbally, relevant to his subject, without taking the trouble to discuss them in their actual context, and he goes on to draw some general and obvious conclusions which leave the reader none the wiser. His main thesis is that "our thinking proceeds by selection and at the same time a correlative neglect", the horizons of our thought have always a beyond, the spotlight leaves a background unilluminated. The author applies this thesis to widely diverse realms, from mathematics to ethics, and deduces more or less relevant conclusions. The reviewer cannot help thinking that Prof. Conger seems to leave in the background most of the problems which he wishes to solve: the spotlight of his analysis ought to go beyond the actual horizon of his thought as expressed in this volume.

Physics

Air Ministry: Meteorological Office. Professional Notes, No. 66: *Lightning and Aircraft*. By G. C. Simpson. Pp. 24. (London: H.M. Stationery Office, 1934.) 4*d*. net.

It is fortunate for aviation that Dr. Simpson should have first become prominent largely through the study of the electricity of thunderstorms, and in virtue of that fact and of his official position as director of the Meteorological Office, it would be expected that a handbook dealing with the risks of damage to aircraft due to lightning would not only be as helpful in that direction as the present state of knowledge allows, but would also be a boon to those seeking to learn something about atmospheric electricity without having to embark upon an elaborate treatise such, for example, as that of Elster and Geitel. This expectation is fully satisfied, for in only twenty-four pages both needs are met. The work of condensation has been so well done that on the theoretical side the average intelligent scientific reader who is not a specialist in atmospheric electricity is not likely to realise the amount of condensation that has been effected. This is a subject in which it is only too easy to find oneself unable to see the wood for the trees, the more so as the trees are often enveloped in a fog of controversy, and after experts have met to discuss its unsolved problems there is apt to be an intellectual battle, and a casual spectator may not be able to distinguish victor from vanquished.

On the meteorological side, a fairly definite picture emerges of the broad facts connected with the separation of the opposite electricities under various types of weather, the impression at the same time being conveyed that much remains to be learned about the mechanisms involved. On the practical side, one gathers that an aviator should not be unduly alarmed at the prospect of his machine being struck by lightning, especially if it embodies a sufficient amount of metal so arranged as to make the whole machine an electrical conductor of low resistance, unless the machine has a trailing aerial leading into the cockpit. When violent atmospherics are encountered, and cumulo-nimbus clouds are seen ahead, a trailing aerial must be hauled in with the utmost dispatch, if the lives of the occupants of the machine are not to be endangered.

Applied Geophysics in the Search for Minerals. By Prof. A. S. Eve and Prof. D. A. Keys. Second edition. Pp. xi+296. (Cambridge: At the University Press, 1933.) 16*s*. net.

In this new edition of their excellent introductory textbook to the rapidly developing science of geophysical prospecting, the authors have kept to the lines of the original work of 1929. Although a brief review of modern developments since that year has been added to each chapter, the book remains restricted to a manual intended rather for the use of non-geophysical mining engineers, geologists and others who have an economic interest in prospecting, than for physicists and theoretical students of geophysics.

Within these limitations, the revisions made by the authors suffice to bring their work up to date, with a few exceptions. The opportunity might have been taken to revise the rather meagre and somewhat inaccurate descriptions of certain instruments which have been developed outside the United States, and for which full descriptions have long been available. For example, the diagrammatic picture of the gravity gradiometer, Fig. 91, still perpetuates the error of representing the radial dimensions as 20 cm., instead of its correct value 4·5 cm., whilst Eversheds's 'earth'-tester is still referred to as a "Megger".

In a book of this type one has no right to expect detailed descriptions of instruments, in all their variety, but one does expect the details given to be accurate in the essential features, and one would prefer the illustrations to refer either to the original models which have a historical value, or to the latest models which replace the obsolete types.

Some of the earlier descriptions of special methods, notably in the electrical chapter, might well have been replaced by more detailed accounts of the modern methods of potential ratio, resistivity and inductive geoelectrical prospecting.

Engineering Radiography. By V. E. Pullin. Pp. vii+136. (London: G. Bell and Sons, Ltd., 1934.) 45*s*. net.

The use of radiographic methods for the examination of welds and castings and for the detection of cavities, cracks and other flaws is rapidly increasing and there must be a considerable demand for an authoritative book dealing with the results so obtained. No one is better qualified than Mr. Pullin to write such an account and he has produced one which is full of interest and essentially practical. He has little to say as regards X-ray plant, a subject adequately treated elsewhere, but has confined himself to such questions as the preparation of the specimen and the interpretation of the radiographs. The book is very fully illustrated with photographs covering a range from simple welds to complicated castings, and alongside the radiographs are given illustrations of the actual flaws revealed by cutting up the specimens. In this way Mr. Pullin effectively demonstrates not only the potentialities but also the limitations of the method.

Of particular interest is the section dealing with γ-ray radiography. While γ-rays require longer exposures and give radiographs with poorer contrast, they possess certain advantages. It is found that X-rays are in general to be preferred when the thickness of the specimen does not exceed the equivalent of 3 in. of steel, while γ-rays give better results with more massive specimens and irregularly shaped castings. On account of its smaller bulk, the γ-ray apparatus can often be used when it is impossible to mount the X-ray tube in a suitable position.

Both the author and the publishers are to be congratulated on the excellence of the illustrations and the general lay-out.

Television for the Amateur Constructor. By H. J. Barton Chapple. Second edition. Pp. xxiii+266+54 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1934.) 12*s.* 6*d.* net.

THE notable part played by amateurs in the early days of long-distance radio communication is mentioned in every history of the subject. In the hope that they will give similar help in the development of television, the author has written this book for amateurs. The transmission of vision by radio is now an accomplished fact. When developed further, it will provide the 'something new' which will prove a welcome tonic to several of the entertainment industries.

Although the developments that have taken place in the art during the last eight years have been marvellous, it has to be remembered that the ear will tolerate a good deal more than the eye. Although early loud-speakers gave travesties of music and speech, they were listened to by many with enjoyment. But as J. L. Baird says in his foreword, no amount of 'looking-in' at a television image will make a twisted line appear straight. The book can be recommended to those who want to make a start in experimenting on television.

Electrical Communication. By Prof. A. L. Albert. Pp. ix+448. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 31*s.* net.

THIS treatise gives a fairly complete account of electrical communication over long distances. We think that perhaps a little more space might have been devoted to explaining the elements of radio communication, but the subject is now so extensive that it is difficult to discuss all branches of it in one book.

After giving the history of the development of electrical communication, and chapters on sound, speech and hearing and the theoretical basis of telephony, a description is given of transmitters, receivers and loud-speakers. Telephone transmission theory is essentially mathematical, but much of what has been given will be intelligible to the ordinary engineer. The author recognises that most engineers in the communication industry are engaged in work which is not technical. Only a few are working at problems like filter design and improving transmission systems. He points out that submarine telephone cables are subject to interference by electrical and magnetic storms like the aurora borealis. At certain times these natural disturbances may render submarine telephone cables inoperative.

A Guide to Electricity: for Home and School. By Dr. Charles F. Smith. Pp. ix+73. (London: Oxford University Press, 1934.) 2*s.* 6*d.* net.

THIS book is an attempt to explain in simple terms the main principles underlying the supply and utilisation of electrical energy, so far as these are of practical importance in the ordinary household. We think the author has been very successful. The definitions given are scientifically accurate, and the explanations given are novel and lucid. We liked the chapter on "Home Practical Work". It is shown how anyone, although he has no previous experience or mechanical aptitude, can carry out interesting and instructive experiments on an ordinary table without any equipment beyond a few electrical fittings, which can be purchased very cheaply, and the use of the domestic electric supply.

The Thermodynamics of Electrical Phenomena in Metals. By P. W. Bridgman. Pp. vii+200. (New York: The Macmillan Co., 1934.) 16*s.* net.

DOES any need exist to do more than tell the reader that Prof. Bridgman discusses, in this compact volume, thermo-electric phenomena, the thermodynamic analysis of the Volta effect, thermionic phenomena, the effect of surface charge on vapour pressure and electron emission, thermo-electric phenomena in crystals, transverse phenomena, and connexions with the electron theory of metals and photo-electric phenomena? Whatever he discusses, new or old, recondite or obvious, Prof. Bridgman can be trusted to invest with an added interest, for the matter under review has passed through the crucible of a vigorous and inquiring mind.

The volume may be heartily commended.

A. F.

Technology

The Manufacture of Gas. Edited by H. Hollings. In three volumes. Vol. 1: *Water Gas.* By Dr. R. H. Griffith. With a Section on Temperature Measurement, by H. C. Exell. Pp. xv+260. (London: Ernest Benn, Ltd., 1934.) 36*s.* net.

ONE of the welcome signs of the industrial revival in England is the increasing number of first-class technical books "made in England" replacing the former translations. This manual on water gas is an example of this trend: the author has practical knowledge of his subject and he has been permitted to use freely the information available at the works of the Gas Light and Coke Company, where there are several plants containing the latest modifications of design. Water gas to-day is required on the largest scale at a very low cost, so that there has been considerable urge to perfect the processes of its manufacture. Its use in the gas industry has been supplemented by other uses and may shortly be exceeded, as it is the cheapest raw material for making pure hydrogen for the synthesis of methanol and other chemicals and for the hydrogenation of coal.

The book is the first section of a new textbook on gas manufacture, and attention is consequently devoted also to oil cracking and the subject of the complete gasification of coal. The gas industry is known to be steadily developing technically under close scientific supervision and without any spectacular expenditure of capital, and the way is clear for

the more extensive application of processes of carbonisation and gasification, thus eliminating the waste resulting from burning raw coal.

Water gas by itself is too low in calorific value to be used as town's gas, accordingly it is enriched with the gas produced by cracking oil: both the theory and practice of this operation are fully described in the book. A desideratum of the gas industry is often said to be a process by which raw coal may be gasified in a single stage, thus combining the ordinary processes of carbonising to coke and the conversion of coke into water gas: the state of knowledge in this subject is set out by Mr. Griffith. A section on temperature measurement is contributed by Mr. H. C. Exell.

Elements of Heat-Power Engineering. By Prof. William N. Barnard, Prof. Frank O. Ellenwood and Clarence F. Hirshfeld. Part 2: *Steam-Generating Apparatus and Prime Movers, Fuels, Combustion and Heat Transmission.* Pp. xi+871. 34*s*. net. Part 3: *Auxiliary Equipment, Plant Ensemble, Air Conditioning and Refrigeration.* Pp. ix+781–1200. 28*s*. net. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.)

TWENTY-TWO years have passed since Prof. Barnard, of Cornell University, and Dr. Hirshfeld, of the Detroit Edison Company, brought out the first edition of their "Heat-Power Engineering". In that interval power station practice has made enormous strides; stations are far larger, units more powerful, installations more complex and thermal efficiencies much higher. With these advances there is every need for frequent revision of textbooks, and in the rewriting of this work Prof. Ellenwood, also of Cornell, has collaborated.

Part 1 of the work, it may be said, deals mainly with thermodynamics; Part 2 is devoted to steam turbines and engines, boilers, heat transmission, fuels, furnaces, combustion, superheaters, economisers and other plant found in central stations, and Part 3 to auxiliary equipment, plant ensemble, air conditioning and refrigeration. There are plenty of sketches, graphs and problems, and though the field covered is necessarily a very wide one, an excellent index makes reference easy. It is a mine of information and should be on the bookshelves of every technical college.

The Alloys of Iron and Tungsten. By J. L. Gregg. (Alloys of Iron Research Monograph Series.) (Published for the Engineering Foundation.) Pp. xii+511. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 36*s*. net.

As a result of the rapid growth of metallurgical knowledge, the difficulty found by new workers in collecting the existing information on any branch of the subject is becoming increasingly great. In an endeavour to overcome this, the American Engineering Foundation is publishing a series of monographs on the alloys of iron with the more important elements. So far, two volumes, dealing with molybdenum and silicon respectively, have appeared, the latest being concerned with the ferrous alloys containing tungsten. The abstracting is excellently done, and the information is clearly and logically presented. At the end of each chapter, the author has summarised the main conclusions which have been reached, not always an easy task as there is here and there some lack of concordance between the results of different workers. For the most part, however, the individual researches are considered uncritically—an eminently desirable procedure in the production of a book of the present type—and as a result it is at once clear where there is room for further work. The service which is being rendered to metallurgy by the publication of these monographs can scarcely be overestimated. This latest addition is most heartily to be welcomed, whilst the others in course of preparation on pure iron and its alloys with carbon, nickel and copper will be eagerly awaited. F. C. T.

Forthcoming Books of Science

Agriculture, Forestry and Horticulture

Longmans, Green and Co., Ltd.—Gardening in East Africa, edited by Dr. A. J. Jex-Blake.

Macmillan and Co., Ltd.—The Diseases and Curing of Cacao, Prof. H. R. Briton-Jones; Diseases of the Banana, Dr. C. W. Wardlaw; Genetics in Relation to Horticulture, M. B. Crane and W. J. Lawrence.

McGraw-Hill Publishing Co., Ltd.—The Theory and Practice of Silviculture, F. S. Baker; Forest Mensuration, D. Bruce and F. X. Schumacher; Economics with Applications to Agriculture, E. F. Dummeier and R. B. Heflebower.

Oxford University Press.—Sylviculture of the Mixed Deciduous Forests of Nigeria, W. D. MacGregor.

Anthropology and Archæology

Philip Allan and Co., Ltd.—A West Indian Pepper Pot, Sir Reginald St.-Johnston.

George Allen and Unwin, Ltd.—Coral Gardens and their Magic, Prof. B. Malinowski.

G. Bell and Sons, Ltd.—The Progress of Archæology, S. Casson.

Jarrolds, Ltd.—Thirty Years with the Philippine Head-Hunters, S. E. Kane.

Macmillan and Co., Ltd.—The Palace of Minos, vol. 4, Sir Arthur Evans.

McGraw-Hill Publishing Co., Ltd.—Race and Culture Contacts, E. B. Reuter.

Methuen and Co., Ltd.—Orpheus and Greek Religion, W. K. C. Guthrie.

Oxford University Press.—The Stone-Age Races of Kenya, Dr. L. S. B. Leakey; From Fetish to God in Ancient Egypt, Sir E. A. Wallis Budge; The Musical Instruments of the Native Races of South Africa, Percival R. Kirby; The Alaskan Natives: a Survey of their Sociological and Educational Status, Dr. H. Dewey Anderson and Dr. Walter Crosby Eells; Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts,

Reliefs and Paintings, vol. 4, Bertha Porter and Rosalind L. B. Moss.

George Routledge and Sons, Ltd.—Sexual Life in Ancient Rome, O. Kiefer.

Williams and Norgate, Ltd.—The Kingdom of Solomon, Prof. J. Garstang; Herbert Spencer's Sociology, Dr. J. Rumney.

Biology

Philip Allan and Co., Ltd.—The Warp and Weft of Life, Evelyn Cheesman.

George Allen and Unwin, Ltd.—Living Things, Richard Palmer.

D. Appleton-Century Co., Inc.—Economic Plants, Dr. E. E. Stanford; The Teaching of Biology, W. E. Cole.

A. and C. Black, Ltd.—The Internal Parasites of Domestic Animals, Prof. T. W. M. Cameron.

Cambridge University Press.—A History of Embryology, Dr. Joseph Needham.

Jonathan Cape, Ltd.—The Physik Garden, Edith G. Wheelright.

Cassell and Co., Ltd.—The Science of Life, vols. 4, 5, 6, 7, 8 and 9, H. G. Wells, Julian Huxley and G. P. Wells; Sea-gulls in London, Seton Gordon; More Living Things for Lively Youngsters, T. J. S. Rowland.

Chapman and Hall, Ltd.—Heredity—Mainly Human, Eldon Moore.

Chatto and Windus.—A Diary of Thomas Henry Huxley, edited by Julian Huxley.

J. and A. Churchill.—An Introduction to Comparative Zoology, F. G. Sorel Whitfield and A. H. Wood.

Victor Gollancz, Ltd.—Modern Marriage and Birth Control, Dr. E. F. Griffiths; The Human Body, Prof. Samson Wright.

Gurney and Jackson.—A Popular Handbook of Indian Birds, Hugh Whistler.

Harper and Bros.—Medicine Marches on, Dr. E. Podolsky; Birth Control: its Use and Misuse, D. D. Bromley.

George G. Harrap and Co., Ltd.—Wild Animals of our Country, W. S. Berridge.

Hodder and Stoughton, Ltd.—The Golden Science Series, Book 3, Elsie V. M. Knight; An Elementary Course in Practical Plant Anatomy, Comyns J. A. Berkeley.

John Lane, The Bodley Head, Ltd.—The Case for Sterilisation, Leon F. Whitney.

J. B. Lippincott Co.—That Heart of Yours, Dr. S. Calvin Smith.

Macmillan and Co., Ltd.—Primitive Land Plants, Prof. F. O. Bower; Everyday Botany, L. J. F. Brimble; A Classbook of Biology, E. Stenhouse; Introductory Biology, E. Stenhouse.

McGraw-Hill Publishing Co., Ltd.—Laboratory Guide in Animal Biology, R. H. Wolcott and E. F. Powell.

Methuen and Co., Ltd.—Mycorrhiza, J. Ramsbottom. Principles and Practice of Preventive Medicine, Dr. C. W. Hutt and Dr. H. Hyslop Thomson; The Conquest of Suffering, Ritchie Calder.

Ivor Nicholson and Watson, Ltd.—Birds in Britain To-day, C. S. I. Ingram and H. Morrey Salmon.

Oxford University Press.—Respiration, J. S. Haldane and J. G. Priestley; The B.C.G. Vaccine, Dr. K. N. Irvine; H. O. Thomas: The Man and his Work; Parasitism and Disease, Dr. Theobald Smith; Biochemical Studies of Nutritional Problems, Prof. J. C. Drummond.

George Routledge and Sons, Ltd.—Fishes and their Ways of Life, Prof. Louis Roule.

Ward, Lock and Co., Ltd.—Ward, Lock's Natural History, edited by Dr. C. Tate Regan; The Complete Book of British Butterflies, F. W. Frohawk.

Williams and Norgate, Ltd.—Birds of Great Britain, W. P. Pycraft.

Chemistry

D. Appleton-Century Co., Inc.—Experimental Studies in Chemistry, R. H. Bradbury.

Eyre and Spottiswoode, Ltd.—The Dictionary of Organic Compounds, vols. 2 and 3, edited by Prof. I. M. Heilbron.

Charles Griffin and Co., Ltd.—A Textbook of Physical Chemistry, vol. 2, Dr. J. N. Friend.

W. Heffer and Sons, Ltd.—Inorganic Chemistry, Prof. G. T. Morgan and F. H. Burstall.

Longmans, Green and Co., Ltd.—Polarimetry, Prof. T. M. Lowry.

Macmillan and Co., Ltd.—Intermediate Chemistry, Prof. T. M. Lowry.

McGraw-Hill Publishing Co., Ltd.—Elimination of Taste and Odor in Water, J. R. Baylis; Unit Process in Industrial Organic Synthesis, P. H. Groggins; Quantitative Chemical Analysis, A. Stock and A. Stahler, translated by W. Patnode and L. M. Dennis; Colloid Chemistry, A. W. Thomas.

Methuen and Co., Ltd.—The Galvanic Cell and Electrolysis, Dr. J. A. V. Butler.

Oxford University Press.—Chemical Kinetics and Chain Reactions, Prof. N. Semenoff.

Engineering

Chapman and Hall, Ltd.—The Flow of Water, G. Bransby Williams; Electrical Measurements and how they are Made, H. C. Turner and E. H. W. Banner; Practical Solution of Torsional Vibration Problems, W. Ker Wilson; Theory of Alternating Current Wave Forms, P. Kemp; Torsional Vibration, W. A. Tuplin; Automatic Protection of A.C. Circuits, Dr. G. W. Stubbings; The Principles of Motor-Fuel Preparation and Application, Prof. A. W. Nash and Dr. Donald A. Howes; Modern Surveying for Civil Engineers, H. F. Birchal; A Symposium on Illumination, C. J. W. Grieveson.

Cambridge University Press.—Wireless, A. W. Haslett; The Scientific Papers and Addresses of Sir Charles Parsons, O.M., the Hon. G. L. Parsons.

Charles Griffin and Co., Ltd.—Concrete Engineering, vol. 2, J. Singleton-Green; Aero Engines, vol. 2, J. D. Frier.

Crosby Lockwood and Son, Ltd.—Aircraft Progress and Development, Capt. P. H. Sumner; Piles and Pile Driving, A. C. Dean; The Theory of Vibrations for Engineers, F. B. Cole; Houses Planned for Comfort, G. G. Samson; Neon, S. Gold.

Alexander MacLehose and Co.—The Story of Telford, Sir Alexander Gibb.

McGraw-Hill Publishing Co., Ltd.—Practical Radio Communication, A. R. Nilson and J. L. Hornung; Standard Year Book, R. Trautschold; Seaplane Design, W. Nelson; Chemical Engineering Plant Division, F. C. Vilbrandt.

Oxford University Press.—Mechanics: a Textbook for Engineering Students, F. Gardner; Internal Combustion Engine, vol. 2, D. R. Pye; Bessel Functions for Engineers, N. W. McLachlan.

Sir Isaac Pitman and Sons, Ltd.—Electric Circuits and Wave Filters, A. T. Starr; Second Year Engineering Science (Mechanical), G. W. Bird; Advanced Surveying, A. A. Jameson; The Air Manual of the British Empire, 1934–35, edited by Squadron Leader C. G. Burge; The Autogyro and how to Fly it, R. A. C. Brie.

Rich and Cowan, Ltd.—Airships in Peace and War, Capt. J. A. Sinclair.

Geography and Travel

George Allen and Unwin, Ltd.—Great Women Explorers, C. Collinson.

Thornton Butterworth, Ltd.—The Conquest of the North Pole, J. Gordon Hayes.

Cambridge University Press.—The World in Outline, E. D. Laborde.

Jonathan Cape, Ltd.—Desert and Forest: Travels in Abyssinian Danakil, L. M. Nesbitt; Tibetan Range, F. Kingdon Ward.

Cassell and Co., Ltd.—The Young Explorers, Dr. E. E. Field.

Chatto and Windus.—Watkins' Last Expedition, F. Spencer Chapman.

Constable and Co., Ltd.—A Desert Journal, Mildred Cable and Francesca and Evangeline French.

Harper and Bros.—Europe: a Geographical Survey, Prof. J. F. Bogardus.

Hodder and Stoughton, Ltd.—Frozen Frontiers, Sir Douglas Mawson.

Jarrolds, Ltd.—Voodoo Fire in Haiti, R. A. Loederer; Junglemania, Dr. A. Torrance; The Conquest of the Earth, L. G. Gibbon.

Macmillan and Co., Ltd.—Highways and Byways of the West Highlands, Seton Gordon.

Methuen and Co., Ltd.—The British Isles, Dr. S. W. Wooldridge and H. W. Cornes; Snow People, N. Taeki.

Sir Isaac Pitman and Sons, Ltd.—Home and Overseas Geography, R. H. Ducé.

George Routledge and Sons, Ltd.—Mid-Ice, Johannes Georgi; North After Seals, T. Williamson.

Geology, Mineralogy and Mining

George Allen and Unwin, Ltd.—The Indian Earthquake, C. F. Andrews.

W. and R. Chambers, Ltd.—The World's Minerals, Dr. L. J. Spencer.

Harrap and Bros.—Ores and Industry in South America, H. Foster Bain and Prof. T. T. Read.

Macmillan and Co., Ltd.—Structural Geology, Prof. Bohuslav Stočes and C. H. White; The Geology and Mineral Resources of Burma, Dr. H. L. Chhibber.

Thomas Murby and Co., Ltd.—Tertiary Faunas, vol. 1, Prof. A. Morley Davies.

Mathematics and Physical Sciences

Blackie and Son, Ltd.—A Textbook of Physics, vol. 5, Modern Physics, E. Grimsehl, edited by Prof. R. Tomaschek.

Thornton Butterworth, Ltd.—Physics, Prof. A. S. Eve.

Cambridge University Press.—Elementary Quantum Mechanics, Dr. R. W. Gurney; Through Space and Time, Sir James Jeans; Experimental Physics: a Selection of Experiments, Dr. G. F. C. Searle; Hydrostatics and Mechanics, A. E. E. Mackenzie; Physical and Dynamical Meteorology, Dr. David Brunt.

Faber and Faber, Ltd.—The Serial Universe, J. W. Dunne.

Victor Gollancz, Ltd.—An Introduction to Mathematics, R. W. Smith.

Charles Griffin and Co., Ltd.—Meteorology, R. M. Deeley.

Macmillan and Co., Ltd.—Solid Geometry, L. Lines; Practical Geometry for Senior and Central Schools, Books 1, 2 and 3, J. A. Crabb; Properties of Matter, S. G. Starling.

McGraw-Hill Publishing Co., Ltd.—The Structure and Properties of Matter, H. T. Briscoe; Answers to Problems in Introductory Mathematics, J. W. Lasley and E. T. Browne; Physical Basis of Things, J. A. Eldridge; Introduction to Mechanics and Heat: Principles of Mathematical Physics, W. V. Houston; Introduction to Atomic Spectra, H. E. White; Applied Shop Mathematics, J. H. Wolfe and E. R. Phelps.

Methuen and Co., Ltd.—An Introduction to Atomic Physics, J. Thomson; The Structure of Spectral Terms, Prof. W. M. Hicks; Low Temperature Physics, L. C. Jackson; High Voltage Physics, L. Jacob; Relativity Physics, Prof. W. H. McCrea; Fine Structure in Line Spectra and Nuclear Spin, Prof. S. Tolansky.

Oxford University Press.—Investigations of Binary Stars, William J. Luyten and assistants.

Sir Isaac Pitman and Sons, Ltd.—Elementary Practical Mathematics (2), E. W. Golding and H. G. Green; Advanced Practical Mathematics, W. L. Cowley.

Rivingtons.—A Compact Arithmetic, W. G. Borchardt.

University Tutorial Press, Ltd.—Mechanics and Hydrostatics for Schools, F. Barraclough; Elementary Electricity and Magnetism, R. W. Hutchinson; Mechanics (Elementary Science Series), G. F. Peaker; Light and Sound (Elementary Science Series), H. G. Lambert and P. E. Andrews.

Metallurgy

McGraw-Hill Publishing Co., Ltd.—The Alloys of Iron and Copper, L. S. Coyle and W. P. Evans.

Oxford University Press.—Metallurgical Spectrum Analysis, W. J. Crock; Distortion of Metal Crystals, Constance F. Elam.

Miscellany

George Allen and Unwin, Ltd.—The History of Science, Technology, and Philosophy in the 16th and 17th Centuries, Prof. A. Wolf.

Thornton Butterworth, Ltd.—Sociology, Prof. Morris Ginsberg.

Cassell and Co., Ltd.—Great Contemporaries (including essays by various authors on Lodge, Marconi, Smuts, Einstein, Freud, Frazer, Rutherford).

Charles Griffin and Co., Ltd.—Science for Sailors, E. C. Millington.

J. B. Lippincott Co.—The New World of Science, A. Frederick Collins.

Oxford University Press.—Proceedings and Scientific Papers of the Fifth Pacific Science Congress held at Victoria and Vancouver, June, 1933.

George Routledge and Co., Ltd.—Collectivist Planning in Economic Life, Prof. F. Hayek; Economic Planning in Soviet Russia, Prof. Boris Brutzkus.

Ward, Lock and Co., Ltd.—Our Wonderful World of Tomorrow, Prof. A. M. Low.

Philosophy and Psychology

George Allen and Unwin, Ltd.—Science and the Human Temperament, Prof. E. Schrödinger, translated and edited by James Murphy.

D. Appleton-Century Co., Inc.—Psychology and Mental Hygiene, E. A. Kirkpatrick; Developmental Psychology, F. L. Goodenough; Parent and Child, E. Schmiedeler and M. Rosa McDonough.

Baillière, Tindall and Cox.—Sex Ethics, Dr. A. Goodwin, C. D. Read, J. Ellison and L. Carnac Rivett.

Cambridge University Press.—Problems of Mind and Matter, J. Wisdom.

Jonathan Cape, Ltd.—The Science of Work, Dr. Viteles.

C. W. Daniel Co.—Dreaming True, J. M. Stuart-Young; The Trail, Olive Pixley; The Whole Man and his Parts, Dr. G. Groddeck.

Harper and Bros.—General Psychology, G. Murphy; Experimental Social Psychology, G. and L. B. Murphy; Psychology and the New Education, S. L. Pressey; Social Psychology, J. K. Folsom; Psychological Tests, Methods and Results, H. E. Garrett and M. R. Schneck.

John Lane, The Bodley Head, Ltd.—Sexual Aberrations, Dr. Wilhelm Stekel, translated by Dr. Samuel Parker.

Macmillan and Co., Ltd.—Introduction to Theory and Practice of Psychology, Dr. Ll. Wynn Jones; Nature, Man and God, Dr. William Temple.

McGraw-Hill Publishing Co., Ltd.—The Problem of Mental Disorder, M. Bentley; Social Psychology, L. G. Brown; Infant Behaviour, A. Gesell and H. Thompson; The Child: his Origin, Development and Care, F. B. Sherbon; Observation of Young Children, L. C. Wagoner; A Dynamic Theory of Personality, K. E. Zener and D. K. Adams.

Methuen and Co., Ltd.—The Backward Scholar, Angus Macrae; The Neurotic and his Friends, R. G. Gordon.

Oxford University Press.—A Handbook of Social Psychology, edited by Carl Murchison.

Technology

G. Bell and Sons, Ltd.—The Kingdom of the Camera, T. Thorne Baker.

Cambridge University Press.—Radio round the World, A. W. Haslett.

Chapman and Hall, Ltd.—Stereoscopic Photography, A. W. Judge.

Eyre and Spottiswoode, Ltd.—The New Modern Gasworks Practice, vol. 2, Alwyne Meade.

Crosby Lockwood and Son, Ltd.—Rubber: its Physical and Chemical Properties, T. R. Dawson and B. D. Porritt.

McGraw-Hill Publishing Co., Ltd.—The Stone Industries, O. Bowles; Mineral Industry, vol. 42, G. A. Roush.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

contains a workroom, kitchen, verandah, and dormitory accommodation, etc. The site is about half an hour's walk from the Narrabeen tram terminus, and is within easy reach of French's Forest, Kuring-gai Chase, Deep Creek and Long Reef. It provides therefore an excellent centre for the study in their native habitats of the fauna and flora of sandstone scrub, forest, palm groves, fresh-water swamps, lagoons and beaches. The neighbourhood is also a sanctuary for native birds The research work to be done at this station, which is the first of its kind to be founded in Australia, will range from simple individual work to extended studies by teams of observers, in which botanists, zoologists and geologists may all take part. Among interesting researches which stand to the credit of senior members of the Society are Prof. W. J. Dakin's work on the food and breeding habits of the fish in Australian coastal waters, and Prof. T. G. B. Osborn's researches on Australian native fodder plants and grasses. The new station will also allow biological students to carry out under ideal conditions the field work which forms part of their training.

Early Plant Hybridisation

FURTHER records of plant hybridisation before Kölreuter are given by Dr. C. Zirkle (*J. Heredity*, **25**, No. 1), his earlier studies of this subject having been reviewed in NATURE of March 18, 1933, p. 393. Many early writers noted different coloured grains on the same ear of maize, the earliest recorded being by Tabernaemontanus (1588). Cotton Mather, in a letter to James Petiver in 1716, which is preserved in the Sir Hans Sloane collection of the British Museum, described natural crossing between different colour varieties of maize. This letter is published in full. Crossing in *Cucurbita* was also described. Thomas Fairchild is generally credited with having produced the first artificial plant hybrid, about 1716. From records of Richard Bradley and the minutes of the Royal Society it is concluded that the hybrid first appeared spontaneously, and was then produced by crossing a carnation as female with the pollen of a Sweet William. Bradley himself recorded *Auricula* hybrids in 1717 and commented on the effect of foreign pollen in several varieties of apples and melons. Other English hybridisers of the same period are Thomas Knowlton, whose observations on *Dianthus* species hybrids were reported to the Royal Society in 1720; Thomas Henchman, Prebendary of Salisbury, who in 1729 noted the crossing of pea varieties and the occurrence of blue and white seeds in the same pod; and Benjamin Cooke, who in the Isle of Wight described crossing between maize varieties in 1749 (*Phil. Trans. Roy. Soc.*, vol. 46). Twelve different investigators have now been found who described plant hybridisation before Kölreuter.

Spread of the Water Hyacinth

IN tropical waters, the water hyacinth, *Eichhornia crassipes*, Solms., a native of South America, a freely floating or loosely attached water plant supported by its curious buoyant bladder-like petioles, very readily becomes a serious pest, blocking waterways to navigation and converting fertile land near the waterways into stagnant swamps. F. P. Jepson, controller of plant pests, Department of Agriculture, Ceylon, has directed attention to the spread of this pest (*Trop. Agric.*, **81**, Dec. 1933). Introduced into Ceylon in 1905, probably as an ornamental plant, it has spread until in 1933 it ranges over some thousands of acres of water, paddy and swamp. At present, the infested areas lie within the inhabited zones, but Mr. Jepson contemplates with dismay the possible results of its finding its way to the vast uninhabited regions traversed by some of the larger rivers. Chemical methods of extinction are still being experimented with, but until now removal by hand has been most effective, the weed being then piled up and burnt. The chief difficulty in the control of the pest has been the apathy of the landowners and others responsible for the irrigation dams and water tanks. For this reason, Mr. Jepson's account is written in an educational and propagandist spirit, and makes clear the necessity for co-operation between private individual and Government if the water hyacinth is to be brought under control.

"Marmite"

THE yeast extract "Marmite" has long been recognised as a source of the vitamin B complex; more recently it has been found of value in various types of anæmia. Marmite has been compared directly with the international standard vitamin B_1 preparation and found to contain 840 international units per oz., so that it is a potent source of this vitamin. It contains also vitamin B_2 and other substances extractable from yeast, among which may be mentioned the 'extrinsic' factor required for normal blood formation. It is now generally considered that normal hæmatopoiesis depends upon the interaction of an 'intrinsic' factor present in the juice secreted by a healthy human stomach and an extrinsic factor present in the food: the compound formed by the interaction of these two factors is stored in the liver. In true pernicious anæmia, there is a deficiency in the secretion of the intrinsic factor, so that cure can only occur when the complete hæmatopoietic factor is supplied, as by giving liver or a preparation of it. In other anæmias, such as tropical macrocytic anæmia, it appears that the intake of the extrinsic factor is deficient; cure can then be brought about by administering marmite. The effectiveness of marmite in anæmia is not due apparently to any constituent of the vitamin B complex present in the extract. Marmite is supplied by the Marmite Food Extract Co., Ltd., London, E.C.3.

Fog Peril to Fishermen Lessened

THE United States fishermen who use dories (small flat-bottomed boats) to fish on the Grand Banks run a serious risk of drifting out to sea in a fog. This danger can now be very successfully overcome by the use of small radio transmitting sets weighing 20 lb. which can signal the position of the scattered

boats to the 'mother' fishing ship. As a boat sets out fishing, it carries one of these sets. When the work is done, if there is a dense fog, the dory sends out a code signal to the mother ship. By means of the radio direction finder the ship carries, the direction of the dory from it is easily found. Tests made from a schooner show that dories can be located up to a distance of six miles. The battery used can give out signals for a week. A description of the method is given in *Electronics* of August.

Japanese Mathematical Journals

IT is interesting to notice how largely the English language is used in some Japanese scientific journals. The *Tôhoku Mathematical Journal* accepts contributions in English, French, German, Italian or Japanese, but of the thirty-three papers in vol. 39, part 2, no less than twenty-four are in English, and only one is in Japanese. The authors are of decidedly varied nationalities, including ten Americans, nine Japanese, four British, three Chinese, two Germans, and one Russian. The subjects treated belong almost entirely to the domain of pure mathematics, with an unusually large proportion of geometry of various kinds (pure, algebraic and differential). The papers in this *Journal* are usually very short. We have also received Science Reports of the Tokyo Bunrika Daigaku (Section A, 2, Nos. 31–32), which contain two mathematical papers of greater length, one in English and one in German, both by Japanese authors.

The Trees of Ireland

THE mild, moist climate of Ireland is particularly favourable to the growth of trees, and Mr. H. M. Fitzpatrick has done a valuable service to both foresters and botanists in gathering together (*Sci. Proc. Roy. Dublin Soc.*, 41, November 1933) particulars of the trees introduced into Ireland, and as to where specimens of these trees may be found. Statistics of tree dimension have been collected from no less than seventy-two estates. The wide variety in conifers is particularly striking in the list. Mr. Fitzpatrick states that broad-leaved trees have been less and less in fashion since the introduction, about 1840, of many of the North American conifers, which flourish so remarkably in the Irish climate.

Guide to Official Statistics

THE volume for 1933 of the "Guide to Current Official Statistics" (H.M. Stationery Office. 1*s*.) has now been published. The main part of the volume is an alphabetical subject index of nearly three hundred pages giving the number of the publication involved. This is followed by a list of publications in serial order which allows the title and price of the blue book or white paper to be found. The indexing is done in much detail, and there should be no difficulty in finding the statistics required. With the help of this annual publication, much valuable information in official volumes is made available to students.

Announcements

LORD MELCHETT will speak on "National Progress in relation to the Monetary System" at a meeting of the Engineers' Study Group on Economics on October 24 at 8 p.m. at Denison House, Victoria, S.W.1. Admission is by tickets, obtainable free of charge from Mr. A. H. Hayes, Hazlitt House, Chancery Lane, W.C.2.

THE following appointments have been made in the Colonial Empire: Mr. L. D. E. F. Vesey-Fitzgerald, to be entomologist to the Sugar-Cane Investigation Committee, Trinidad; Mr. R. A. Hamilton, to be assistant chemist to the Sugar-Cane Investigation Committee, Trinidad; Mr. G. D. Huggins, assistant agricultural superintendent, British Guiana, to be agricultural superintendent, British Guiana; Mr. J. V. Collins, deputy Government analyst, Ceylon, to be Government Analyst, Ceylon; Mr. G. W. St. C. Thompson, formerly botanist, Tsetse Research Department, Tanganyika Territory, to be Assistant Conservator of Forests, Gold Coast.

IT is announced from the Royal Institution that single tickets admitting to one afternoon lecture can now be obtained by non-members. Books of single tickets, which are transferable, are also available, and season tickets for the sessions before and after Christmas respectively can be obtained.

THE Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals will shortly be making awards from the Beilby Memorial Fund. These awards are given to British investigators in science to mark appreciation of records of distinguished original work, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. The administrators of the Fund will be glad to have their attention directed, not later than October 27, to outstanding work of the nature indicated. Correspondence should be addressed to the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior lecturer in physics at the Military College of Science, Red Barracks, Woolwich, S.E.18—The Commandant (Oct. 31). A professor of economics at Armstrong College, Newcastle-upon-Tyne—The Registrar (Nov. 12). A temporary assistant metallurgist at the Research Department, Woolwich, S.E.18—The Chief Superintendent. An irrigation adviser to the Palestine Government—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1. A lecturer in physics at the University of Rangoon (University College)—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1. An assistant in the Mechanical Engineering Department of Guildford Technical College—The Director, Technical College, Park Street, Guildford. An assistant in radio research in the Directorate of Scientific Research of the Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hampshire.

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.*]

Language Distribution of Scientific Periodicals

THE recently issued second edition of the "World List of Scientific Periodicals" (see NATURE, Sept. 22, 1934) provides a census of the current scientific periodicals throughout the world. The detailed thoroughness of the work, executed under the editorship of Mr. W. A. Smith, of the British Museum, with an expert staff, the advantage taken by them in regard to comprehensiveness of entry, from experience gained in the first edition now nine years ago, and the very magnitude of the list arrived at, extending to more than 36,000 individual titles, allow the supposition that in this conspectus we have the total current output of scientific periodicals of the world represented with something like exhaustive completeness.

To-day periodicals constitute the main bulk of scientific literature. They furnish the main channel for publication of new scientific discoveries and inventions. They form a chief medium for the exchange and discussion of new views. They can be accepted therefore as constituting in large measure an index to scientific activity. For obtaining a view of the contributions to scientific activity furnished from different parts of the world, an interest attaches therefore to the quota, toward the general output of such periodicals, traceable severally to some of the main contributory groups throughout the world. To assess this the number of titles belonging to a given language as recorded by the "World List" may be taken as some guide. The "World List" itself covers eighteen different languages. Without carrying the inquiry further than the five languages English, French, German, Italian and Russian, the results come out, following them in reverse order to the above, as follows :

Russian . .	1,833	scientific periodicals.
Italian . .	1,667	,, ,,
German . .	6,186	,, ,,
French . .	5,013	,, ,,
English . .	13,494	,, ,,

Relatively one to another, the numerical sizes of these groups may be accepted as carrying some indication as to how scientific activity bulks relatively under these several linguistic headings. Scientific production will obviously be a part of the scientific activity thus indexed. An inference also allowable, within limits, will be as to the relative size of that fraction of the world-public which is reached by science through the medium of each of the several languages. The results cited above make evident the special responsibility resting on those contributors to science whose language is English to spare no pains to write it worthily of the great rôle entrusted to it as a medium of scientific thought to-day.

C. S. SHERRINGTON.

Physiological Laboratory,
University Museum,
Oxford.

Wine Makers and Bottle Makers: a Parable

A CERTAIN country was noted for its wonderful native wines, both sparkling and mellow. Grapes were grown by small individual owners, and each specialist was proud of his product and of its distinct taste. For fermentation and ageing, wine was poured into various casks, skins, bottles, jugs, etc., as the case might be. From time to time there was some talk about the containers being not always satisfactory and certainly not uniform. Gradually the makers of bottles and jugs organised an association to improve and to standardise their products, so as to provide the wine makers with better containers and thereby to assist them both in the production and marketing of the wines.

It so happened that while it was easy for the bottle makers to become organised (their product being standard and comparatively easy to manufacture), the wine makers continued their individual production, at least for the choicest vintages, where intimate individual knowledge, skill and professional pride were important factors. As time went on, there was more and more talk about excellent bottles and less and less talk about the wines themselves, because the organised bottle makers had better publicity channels. In some cases fancy mass-production bottles began to be used for mediocre wines, thus discouraging the best viniculturists.

To make the situation worse, the bottle makers conducted their activities as part of the wine making industry, and the wine makers were only invited from time to time as a favour to sit with them in their discussions. To make the camouflage complete, the bottle makers adopted for themselves the honorary degrees which the wine makers originally used to bestow upon their own distinguished confreres, such as Master of Fizz and Doctor of Fermentation, although the recipients from among the bottle makers did not even understand the meaning of the words. Every time an intricate technical problem in wine making arose, the bottle makers appointed an elaborate committee of their own men, with the final result that a bottle of a somewhat different shape was recommended as a remedy, even though the difficulty may have been of chemical or bacteriological nature.

The bottle makers' association grew and prospered. Not satisfied with bottles for wine, the association appointed representatives to sit on joint committees with makers of other kinds of containers, such as bath-tubs and garbage cans, it being assumed that they had much in common. In the meantime, less and less of exquisite rare wines began to be produced, and more and more of 'vin ordinaire' of uniformly sour taste, sold in various fancy bottles. Finally, the more discerning consumers from abroad ceased buying wine from this particular country, and warehouses became filled with empty bottles of all kinds of fancy shapes. Some of the wine growers went into other pursuits, some continued outside the association, and some began forming small professional circles of their own, very simple in external form, and devoted exclusively to real improvements in the quality of wines and general theory of grape culture and fermentation. Full membership was restricted to actual grape growers and wine makers ; anyone interested as an amateur could become an associate member, but bottle makers were strictly excluded. In some circles, to be admitted one even

had to prove that neither of his grandfathers was a bottle maker or related to one.

In the end the cycle was completed and the wine growers again acquired the prominence due them, while the bottle makers' association became too top-heavy to continue to exist. Individual bottle makers found their proper modest function furnishing simple reliable bottles as specified by the wine makers. From the temporary flare-up, when the bottle makers came near ruining the wine industry by their over-zealousness and naïve conceit, some of the puzzling old sayings originated, such as, "tell your troubles to the bottle makers", or "try a different shape bottle".

VLADIMIR KARAPETOFF.

Department of Electrical Engineering,
Cornell University,
Ithaca, N.Y.

Nuclear Structure and Excited Radioactivity

FOLLOWING Heisenberg and Landé's suggestion, completed by Walke[1], every atomic nuclear can be considered as constituted by α-particles (α), deutons (π_2) and neutrons (n), according to the formula :

$$x\alpha + y\pi_2 + zn.$$

x, y, z must satisfy the equations

$$4x + 2y + z = A$$
$$2x + y = N$$

where A is atomic mass, N atomic number. For x one must choose the greatest possible value, when $y = 0$ or 1.

An examination of the table of all isotopes shows that the following formulæ

$$(1)\ \begin{cases} x\alpha + \pi \\ x\alpha + \pi_2 \text{ (for } x > 3) \\ x\alpha + \pi_2 + \pi \end{cases} \qquad (2)\ \begin{cases} x\alpha + \pi_2 + zn \ (z \text{ even}) \\ x\alpha + zn \ (z \text{ even}, x < 4) \end{cases}$$

do not correspond to any known stable isotope. It should be noted here that $x\alpha + \pi$, $x\alpha + \pi_2 + \pi$ do not agree with the general form $x\alpha + y\pi_2 + zn$; they correspond to exceptions. It may therefore be concluded that they represent nuclei of unstable isotopes. It is easy to see that formulæ (1) lead to a positive electron emission ; the formulæ (2) to a negative electron emission.

The formula for nuclear structure also makes it possible to predict the reactions involved in artificial radioactivation.

The various possible cases are :

(1) $y = 1$, z odd, nuclear formula $x\alpha + \pi_2 + zn$;
(2) $y = 1$, $z = 0$, nuclear formula $x\alpha + \pi_2$;
(3) $y = 0$ nuclear formula $x\alpha + zn$.

In each case, it is easy to investigate the action of the various particles : α-particles, protons, deutons or neutrons ; and always we arrive at a formula of an unstable isotope.

For example, in case (1) the neutrons give :

$$(x\alpha + \pi_2 + zn) + n = x\alpha + \pi_2 + (z + 1)\,n$$
$$\text{or } [(x - 1)\alpha + \pi_2 + (z + 1)n] + \alpha\uparrow$$

two possible reactions which lead to two various periods ($_9F^{19}$, $_{11}Na^{23}$, $_{13}Al^{27}$ . . .).

In case (2), the α-particles give

$$(x\alpha + \pi_2) + \alpha = [(x + 1)\alpha + \pi] + n\uparrow$$
($_3Li^6$, $_5B^{10}$, $_7N^{14}$).

In case (3), the neutrons give

$$(x\alpha + zn) + n = [(x - 1)\alpha + \pi_2 + (z + 2)n] + \pi\uparrow,$$

the resulting nucleus being unstable if z is even or zero ($_{12}Mg^{24}$, $_{14}Si^{28}$, $_{16}S^{32}$, $_{26}Fe^{56}$ . . .).

A full account of the results will appear shortly in the *Annales de la Société scientifique de Bruxelles*.

G. GUÉBEN.

Université de Liége.
Sept. 15.

Walke, *Phil. Mag.*, **17**, 793 ; 1934. **18**, 129 ; 1934.

Ionisation of Gases by Atom Beams

ON the ionisation of gases by particles of atomic mass (ions and atoms) very few results have been obtained hitherto. As regards neutral atoms with moderate energy (less than 1,000 electron-volts), the only available data are those referring to the effective cross-sections for ionisation of argon by argon atoms with 500 and 650 e.v. energy, as determined lately by O. Beeck and H. Wayland[1] ; earlier work by Beeck and by C. J. Brasefield[2] being of a rather qualitative character, and their results uncertain.

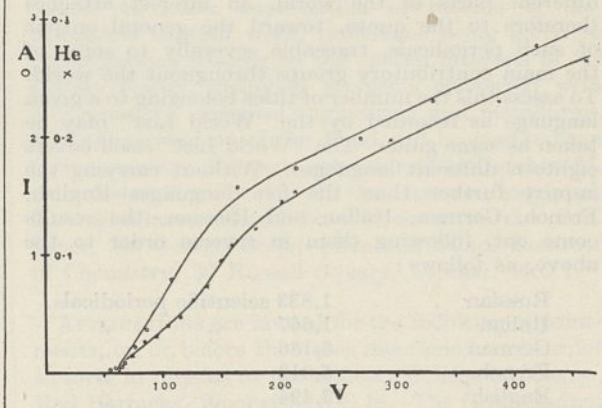

FIG. 1.

I have been able lately to determine the effective cross-sections for ionisation of argon and helium by their own atoms with an energy varying between 50 and 700 e.v. The values are given in the accompanying diagram (Fig. 1). Both curves fall abruptly at small values of the energy, and they both reach the abscissa at a value of nearly 60 e.v. The value of the cross-section for helium is about a tenth of the corresponding values for argon. A full account of the investigation will be published *in extenso* in *Nuovo Cimento*[3].

A. ROSTAGNI.

R. Istituto fisico, Torino.
Aug. 29.

[1] O Beeck and H Wayland, *Ann. Phys.*, **19**, 129 ; 1934.
[2] O. Beeck, *Proc. Nat. Acad. Sci.*, **18**, 311 ; 1932. *Z. Phys.*, **76**, 799 ; 1932. C. J. Brasefield, *Phys. Rev.*, **42**, 11 ; 1932. **43**, 785 ; 1933.
[3] See also *La ricerca scientifica*, July–August, 1934.

Specific Gravity of Lapis Lazuli

IN the course of some work on lapis lazuli, we were astonished to find how wide was the discrepancy between the specific gravities of our specimens and the values accorded to this rock by all the standard textbooks. Of more than five hundred representative specimens examined, we found that 95 per cent had specific gravities falling within the range 2·75–2·90, the extreme limits being 2·45 and 2·94. Ever since the 1850 edition of Dana's "System", the figures almost universally quoted have been 2·38–2·45. This value is derived from Breithaupt's "Handbuch" (1847), in which he states that he found the density of "quite pure grains" to be 2·406, and gives as the range 2·38–2·42. 2·5–2·9 (Dana's "System" 1844 Ed.) and 2·76–2·95 (Brisson : "Pésanteurs Spécifiques des Corps", Paris, 1787) are examples of the better values given prior to Breithaupt.

As the specific gravity provides a constant of considerable importance for testing purposes, it is to be hoped that future works on mineralogy will revert to more representative figures for this widely-used material.

B. W. ANDERSON.
C. J. PAYNE.

Laboratory of the Diamond, Pearl and Precious Stone Trade Section of the London Chamber of Commerce, 55, Hatton Garden, E.C.1.

Chemistry of Anaerobic Recovery in Muscle

The three series of major chemical changes which are associated with muscular activity, namely : disintegration and resynthesis of adenosinetriphosphoric acid ; disintegration and resynthesis of phosphocreatine ; and glycogenolysis, or transformation of glycogen into lactic acid, have been considered, until recently, as independent chemical reactions, but as in some way linked—energetically and chemically. It was known that the presence of adenosinetriphosphoric acid is a condition of glycolysis in muscle, and that glycolysis is a condition of the resynthesis of adenosinetriphosphoric acid from adenylic acid and phosphates. Recently it has been made clear, by Lohmann[1], that the resynthesis of adenosinetriphosphoric acid from adenylic acid is brought about by splitting off phosphate groups from phosphocreatine ; at the same time, we have demonstrated[2] the linkage between glycogenolysis and the resynthesis of adenosinetriphosphoric acid, depending probably on the intermediate resynthesis of phosphocreatine, and this later linked to a definite intermediate step of glycogenolysis.

Taking into consideration some further facts, for example, that the dephosphorylation of adenosinetriphosphoric acid does not lead, in iodoacetate poisoned muscle, to free phosphates, but to carbohydrate-phosphoric esters, we come to certain conclusions concerning the linkage of the three series, which can be pictured, tentatively, in the following equations :

1. $C_5N_5H_4.C_5H_8O_4.PO_3H.P_2O_6H_3 + \frac{1}{n}(C_6H_{10}O_5)_n + H_2O =$
adenosinetriphosphoric acid glycogen
$= C_5N_5H_4.C_5H_8O_4.PO_3H_2 + C_6H_{10}O_6(PO_3H_2)_2$
adenylic acid fructosediphosphoric ester

2. $C_5N_5H_4.C_5H_8O_4.PO_3H_2 + 2C_4H_7N_3O_2.PO_3H_2 =$
phosphocreatine
$= C_5N_5H_4.C_5H_8O_4.PO_3H.P_2O_6H_2 + 2C_4H_8N_3O_2$
adenosinetriphosphoric acid creatine

3. $C_6H_{10}O_6(PO_3H_2)_2 + 2C_4H_8N_3O_2 = 2C_3H_6O_3 + 2C_4H_7N_3O_2.PO_3H_2.$
fructosediphosphoric ester creatine lactic acid phosphocreatine

The third reaction is obviously simplified ; the second is Lohmann's reaction. It will be noted that the ultimate effect of the whole transformation is the conversion of glycogen into lactic acid ; and that the three series appear as intermediate reactions in this conversion.

We consider the above changes as the main course of the changes connected with anaerobic recovery, to which, of course, the well-known minor changes, such as ammonia formation from adenylic acid, are subsidiary reactions.

J. K. PARNAS.
P. OSTERN.

Department of Chemistry, University Medical School, Piekarska 52, Lwow.
Sept. 2.

[1] C. Lohmann, *Biochem. Z.*, **271**, 264, 278 ; 1934.
[2] J. K. Parnas, P. Ostern, T. Mann, *Biochem. Z.*, **272**, 64 ; 1934.

Effect of the Male Sex Hormone on the Genital Tract of the Female

BROUHA and Simonnet[1] have already given evidence that testicular extracts produce œstrus in castrated rats, as shown by the cornification test, causing also the proliferation of the uterine mucous membrane in immature female rats. A similar reaction has been observed after injections of the male hormone extracted from the urine (hombreol)[2]. The horns of the uterus increase, their lumens fill up with the excreted fluid, the glands and muscular layers are better developed and the epithelial cells become elongated. These changes are comparable to those caused by the female sex hormone. The fact that both the female and the male hormones affect the genital tract of the female similarly is, I think, in accord with the results of recent biochemical work[3,4]. It is interesting to note that the proliferational changes are most striking in animals treated simultaneously with the male and female hormones.

Analogous changes, though perhaps less accentuated as regards the glands and epithelium, can be induced by the male hormone in rabbits 10–60 days old. Ten day old female rabbits give a macroscopic positive reaction (increase of the uterus and its hyperæmia) and also a positive microscopic reaction on the day after the last of three subcutaneous injections given every second day and containing a total of about 15 capon units.

This test can therefore be used in examining the activity of preparations free from the greater quantities of the female sex hormone ; it gives satisfactory results on unoperated animals without histological examination of the uterus wall. Younger animals (4–5 days old) react in a lesser degree. In this connexion, it is perhaps worth stating that, in immature female rabbits, the male and female hormone (in the proportion of 1 c.u. to 10 m.u.) produce quantitatively the same effect, and that the female organism does not react earlier in its development to the female hormone than to the male hormone.

ST. SKOWRON.

Biological Laboratory, University, Cracow.
Sept. 21.

[1] *C. R. Soc. Biol.*, **99** ; 1928.
[2] St. Skowron and E. Turyna, *Pol. Gaz. Lek.*, Nr. 18 ; 1934.
[3] W. Schoeller, E. Schwenk and F. Hildebrandt, *Naturwiss.*, Jahrg. 21, 1933.
[4] W. Dirscherl and H. E. Voss, *Naturwiss.*, Jahrg. 22, 1934.

A New Glycoside from Madder

ALIZARIN and purpurin have always been described as the two chief tinctorial substances of madder. I have found that the purpurin obtained from madder does not derive from a previously suspected purpurin glycoside but from a glycoside of pseudopurpurin. (Alizarin is 1 : 2-dihydroxyanthraquinone, purpurin is 1 : 2 : 4-trihydroxyanthraquinone and pseudopurpurin is purpurin 3-carboxylic acid.)

While ruberythric acid (the alizarin glycoside) has been known for many years, the second tinctorially important glycoside of madder has not been previously isolated; though its presence was first recognised by Kopp in 1861. A glycoside of pseudopurpurin has now been prepared by me from the roots of the wild madder (*Rubia peregrina*) and the yellow bedstraw (*Galium verum*). The substance is very soluble in water, from which it readily crystallises in minute needles, and forms a bright yellow powder, showing no definite melting point owing to decomposition. It appears to be a 1-monopentoside of pseudopurpurin, and is very easily hydrolised. It can be isolated as follows. Fresh roots being extracted with boiling water, normal lead acetate precipitates the crude glycoside. The precipitate is extracted with 1 per cent acetic acid, impurities removed by the addition of more lead acetate, and then ammonia throws down a purer lead compound which is decomposed by 1 per cent H_2SO_4. The glycoside is extracted from the acid solution with butyl alcohol, and then removed by aqueous ammonium carbonate. The ammonia being blown off by air on a water bath, the warm concentrated aqueous solution gives crystals of the glycoside on cooling.

As the glycoside of pseudopurpurin is found only in the genera of the tribe *Galieæ* of the *Rubiaceæ*, the name '*galieide*' is suggested for this substance.

Galieide is responsible for the dyeing properties, known in antiquity, of our native bedstraws (*Galium*). Alizarin occurs only in small quantities in a few species, but the dyers' madder (*Rubia tinctorum*), which is scarcely found apart from cultivation, yields equal quantities of alizarin and pseudopurpurin. Alizarin was the most useful constituent from the dyers' point of view as it was the only one involved in the dyeing of turkey red with madder. The wild madder (*R. peregrina*) has strong tinctorial properties due mainly to galieide, and contains only a negligible amount of alizarin.

R. HILL.

Biochemical Laboratory,
Cambridge.

Microchemical Detection of Elementary Sulphur

THE only method so far known for the detection of small amounts of *elementary* sulphur is unsatisfactory: it consists, in principle, in isolation of the free sulphur of the material under test by sublimation or extraction, followed by examination of the crystal form and of the chemical reactions. Fractions of a milligram of elementary sulphur cannot be detected by this method, and it also fails with larger amounts if the sample contains organic substances which, like sulphur, sublime and have similar solubility.

The following method, which is free from the above disadvantages, has been worked out, chiefly for the purpose of detecting free sulphur, in the presence or absence of combined sulphur, in biological material. The substance to be tested is thoroughly ground with benzylimido-di-(*p*-methoxyphenyl)-methane (I) and a sample of the mixture is introduced into a melting point tube. The tube is placed for five minutes in a bath previously heated to 210° and then the contents of the tube are extracted with a few drops of benzene. If the substance contains elementary sulphur the extract is coloured blue. This blue colour decreases in intensity within a few hours if a crystal of mercuric chloride is added, and the surface of the crystal acquires an intense red colour. The blue colour appears as the result of the formation of the blue thioketone, *pp'*-dianisylthioketone (II), whilst the red colour is due to the formation of an addition compound of the thioketone and mercuric chloride. The addition compound has the constitution (III) or (IV).

Very small amounts (0·04 mgm.) of elementary sulphur can be detected without difficulty by this method. The reagent (I) does not react with combined sulphur.

$$Ar = p\text{-}CH_3.O.C_6H_4\text{-}$$

(I) $Ar_2 : C : N.CH_2C_6H_5 \xrightarrow{S} Ar_2 : C : S$ (II)

(III) $Ar_2 : C : S \ldots\ldots Hg Cl_2$ $\qquad$ $[Ar_2 : C\,]Cl$ (IV)
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \dot{S}\,HgCl$

The reagent (I) is obtained by the action of benzylamine on the chloride of dianisylketone ($Ar_2 : C : Cl_2$), or by the action of dianisylthioketone (II) on benzyl azide ($C_6H_5.CH_2.N_3$).

My thanks are due to W. Urban for his co-operation in this work.

ALEXANDER SCHÖNBERG.

Technische Hochschule,
Berlin-Charlottenburg.
Medical Chemistry Dept.,
University of Edinburgh.

The *p*H of Serum Inactivated by Heat

WE have shown, in recent years, that the inactivation of serum, or destruction of alexin by heat, is accompanied by a number of physical or physico-chemical phenomena which characterise the critical temperature of 55°–57° C. They are: increase in viscosity (after an absolute minimum around 56°[1]), increase in rotatory power[2], increase in absorbed light[3], increase in scattered light[3], increase in the factor of depolarisation[4], increase in electric resistivity[5], sharp change in the rate of sedimentation of globulins after dilution with water[6], decrease in the amount of ether fixed by shaking[7], change in the interfacial tension against oils[8]. A new phenomenon is to be added to the list, namely, an increase in the hydrogen ion concentration, expressed by a drop in the *p*H.

Up to the present time, the data provided by literature were scant and contradictory. Lieberman, Tangl (1907), Seligman (1908), Hugo Hecht (1923), for example, state that inactivation of serum is accompanied by an alkalinisation, while Michaelis and Rona (1909) and Davidsohn (1910) found that no change greater than the experimental errors took place. Sörensen and Jürgensen (1911–13), who worked on the *p*H of serum, did not work under the same conditions and studied mainly coagulation after acidification at *p*H 4·70.

In order to make a very large number of determinations of *p*H of serum under the best possible conditions of accuracy, rapidity and ease, we developed a new rotating hydrogen electrode[9], which enabled us to reach the third decimal point in about five minutes, with 0·4 c.c. of liquid. Three or four bubbles of hydrogen, containing carbon dioxide in equilibrium with the samples under experiment, are required. Good temperature control by circulating water around hydrogen and calomel electrode is provided.

Under such conditions we found that, after heating for 10 minutes in sealed tubes, a lowering of the *p*H always takes place. The minimum is usually observed around 60° C., but sometimes at 62° and even 63°. After the minimum of acidification is reached, the value of the *p*H fluctuates around this value, and sometimes shows a marked tendency towards higher *p*H values (alkalinisation).

This is true of all sera studied so far (mammals), whether pure or diluted with isotonic solution, provided the serum is handled throughout under a layer of neutral paraffin oil in order to avoid the loss of carbon dioxide. Failure to prevent this loss explains the alkalinisation reported by previous workers, and the lack of sensitivity of the method of measurement accounts for absence of variation reported by the others. The amplitude of the drop in *p*H is indeed small, and its mean value (more than four thousand experiments were made) is 0·05 *p*H. The extremes observed were 0·03 and 0·07 *p*H.

Increase in the time of heating does not result in an increase in the amplitude of the drop. The only difference observed is its displacement towards lower temperatures: the minimum occurs around 58°. When the serum is diluted with isotonic solution before heating, the amplitude of the drop is increased (up to 0·1 *p*H), and shifted towards higher temperatures, and the decrease begins around 55°.

P. LECOMTE DU NOÜY.

Institut Pasteur,
Paris.
Oct. 2.

[1] Lecomte du Noüy, *Ann Inst. Pasteur*, **42**, 742; 1928. *J. Gen. Physiol.*, **12**, 363; 1929.
[2] Lecomte du Noüy, *Ann. Inst. Pasteur*, **43**, 749; 1929.
[3] Lecomte du Noüy, *Ann. Inst. Pasteur*, **44**, 109; 1930.
[4] Lecomte du Noüy, *Ann. Inst. Pasteur*, **45**, 251; 1930.
[5] Lecomte du Noüy, *Ann. Inst. Pasteur*, **50**, 127; 1933.
[6] Lecomte du Noüy, *Ann. Inst. Pasteur*, **48**, 187; 1932.
[7] F. Seelich, *Biochem. Z.*, **250**, 549; 1932. **268**, 34; 1934.
[8] F. Seelich, *Biochem. Z.*, (in press).
[9] Lecomte du Noüy, *C.R. Acad. Sci.*, **193**, 1417; 1931. *Science*, **75**, 643; 1932.

Whales and Caisson Disease

PROF. KROGH'S interesting comments[1] on the physiology of the blue whale and how it escapes caisson disease stimulate further speculation. Capt. Damant[2] suggested that at ten atmospheres' pressure below the surface the whale's lungs and the gaseous contents might be compressed to one tenth of the normal volume and in this way the absorption of nitrogen might be retarded. Prof. Krogh replied that he could not picture the whale's thorax and lungs compressed to this extent.

There is another possibility not yet recorded so far as I know. When the whale submerges deeply it may not contain any gas in its lungs at all. It may fill its lungs with sea-water and in this way avoid all extreme compression of lung tissue. Also, as there is no free nitrogen gas in the lung, in such a case all danger of bubble formation in the tissues is excluded. This theory assumes that the whale is able to do without oxygen for considerable periods, after it has breathed at the surface. The animal may accumulate a considerable oxygen debt under water. The water freed from the whale when it blows has always appeared to me to be too substantial to be merely vapour mixed with air from the lungs. The whale may tolerate sea-water in its lungs.

J. ARGYLL CAMPBELL.

National Institute for Medical Research,
Hampstead, London, N.W.3.
Oct. 8.

[1] NATURE, **133**, 635, April 28, 1934.
[2] *ibid.*, p. 874.

Science at the Universities

I AM grieved to infer, from his letter in NATURE of October 13, that Prof. Haldane thinks that I have no soul. The skittle that he knocks down with such gusto is not mine. If he had read my address with more care, he might have discovered that the remarks which he quotes have no bearing on the question how far a knowledge of biology is useful to the average citizen: they refer solely to the danger of encouraging too many students to study intensively a highly specialised branch of knowledge. Let me ask him two questions:

(1) Does he really think that a highly specialised training in any branch of knowledge is an essential ingredient of good citizenship?

(2) Which is more likely to make a man a good citizen? To find that the world wants him, or to find that it does not?

Prof. Haldane really ought not to stupefy himself with catch-phrases. He accuses me of regarding biologists as mere commodities. A commodity is a useful thing with a marketable value. I have not the least objection to being regarded as a commodity in that sense; nor have I any reason to believe that biologists, as a class, are more sensitive. What a "mere commodity" means, I do not know; except that one says "mere" when one wants to be vaguely insulting. But the insult is Prof. Haldane's; not mine. He thinks that my opinions will encourage "revolutionary views" among university students. Let me assure him that it seldom worries a young man to find that he has a good marketable value; what worries him is to find by bitter experience, after years of intensive study, that he has little or no marketable value.

H. T. TIZARD.

Oct. 15.

The Philosophy of Sir James Jeans

DR. CAMPBELL[1] seems himself to have missed the point. I agree with him (though I should not so express it) that "there is not nearly as much difference between the old and the new as Jeans, Eddington and their followers pretend". This was—obviously, I should have thought—my contention in the original article. The point at issue with Dr. Jeffreys is whether the "old" science *realised its character* so well as the "new"—quite a different thing.

H. D.

[1] NATURE, **134**, 571, Oct. 13, 1934.

Research Items

Heredity and Disease in Man. Dr. L. S. Penrose's Buckston Browne prize essay is a discussion of heredity as a factor in human disease, and is written from the medical point of view (London: H. K. Lewis and Co., Ltd. 5*s*. net). The obsolete term "unit characters" is retained, and the author makes a slip in stating that "characters" are arranged within the chromosomes. Nevertheless, a serious and, to a considerable extent, successful attempt is made to harmonise the genetical and statistical points of view as regards inheritance. Among other results is included a study of a pedigree in which idiocy appears as a simple recessive, the heterozygotes developing senile dementia. From the statistical analysis of various families containing mental defectives, the conclusion is reached that in certain consanguineous families this condition is caused by single rare recessive genes, while in other families more complex relations obtain. Other conditions in which the inheritance element is analysed include mongolism, epilepsy and epiloia. It is suggested that sporadic cases of epiloia arise as mutations, and that the inheritance is dominant, although some cases are more in conformity with a recessive inheritance. A brief discussion of medicine and eugenics closes with the suggestion that in collecting pedigrees they may usefully be confined to only two generations, a suggestion which will not be generally accepted.

Vitamin Research in the U.S.S.R. A report of the first two years' work of the newly-formed Vitamin Laboratory of the Institute of Plant Industry appears as a collection of papers by Ivanov and his co-workers, forming Supplement 67 to the *Bulletin of Applied Botany, of Genetics and of Plant Breeding*, Leningrad, 1933 (in Russian, with short English summaries). Much of the laboratory work has been devoted to the discovery of a technique suitable for vitamin C investigations under Russian conditions. For example, the usual basal diets fed to guinea pigs in vitamin C investigations were discarded as a result of this work in favour of a diet of oats, autoclaved hay and autoclaved carrots. The symptoms of vitamin C deficiency were also studied in relation to the growth rates of the guinea pigs. Investigations have been carried out into the vitamin A and C content of varieties of cultivated plants, and into the effect on these of external conditions. It has been found, for example, that certain varieties of cabbages and potatoes have a lower vitamin C content under northern conditions. The effects of various processes normally used in the preparation and preservation of foods in Russia have also been the subject of experiments.

Pangolins and Aard-Varks. The American Museum Congo Expedition returned with ninety-five scaly anteaters or pangolins and thirteen aard-varks. Robert T. Hatt groups the former in a single genus *Manis*, within which he recognises as sub-genera the terrestrial and arboreal forms regarded by Pocock and others as representatives of full genera (*Bull. Amer. Mus. Nat. Hist.*, 66, 643; 1934). Specific characters are remarkably constant, and within the species of pangolins there appears to be no geographical differentiation. With the aard-varks the opposite holds true, although it may be that lack of material and insufficient diagnosis are partly responsible for the existence of sixteen races. Field notes on the habits of both groups of animals are included in the paper, and for the first time a well-marked sexual dichromatism has been noted in adult aard-varks.

Penguin Embryos. The *Terra Nova* Expedition of 1910 brought back three embryos of the emperor penguin and thirteen of the Adelie penguin. After several vicissitudes these have now been described by C. W. Parsons (British Antarctic *Terra Nova* Expedition 1910, Zoology, 4, No. 7, 1934). The unique emperor material showed no striking differences from other penguin embryos: the wing-bones, although distinctly betraying their ultimate form, lacked some of the adult fusion, and the feather papillæ closely resembled those of the gentos. In the Adelie embryos it was noted that the primitive slender condition of the tail was retained in development longer than in the fowl, and the author suggests that such persistence of a primitive character may be significant ancestrally.

The Freshwater Medusa, *Craspedacusta*. Dr. Emil Dejdar has recently published a complete account of the freshwater medusa *Craspedacusta sowerbii* (*Z. Morph. und Ökol. der Tiere*, Abt. A. der *Z. wissenschaft. Biol.*, 28, 5 (Schluss-) Heft., August 1934). The medusa was found in the *Victoria regia* tank, Regent's Park, London, in 1880, and the first notice of it was published in NATURE (22, 178, 218, 290; 1880) as *Limnocodium victoria*. The polyp (*Microhydra*) was first found in 1884 in the pool in the House for Medicinal and Economic Plants of the Royal Botanic Society of London (NATURE, 31; 1884) as "a hydroid form phase of *Limnocodium sowerbii*". Later on, both medusa and polyp were found in the open in their natural habitats, the species being of almost world-wide distribution. It is now fully established that *Microhydra ryderi* is the sessile stage of the medusa *Craspedacusta sowerbii*. In England, the only known locality for the medusa is the Exeter Ship Canal, where it was discovered by Mr. Vallentin, and is very abundant. Owing to the minute size of the hydroid phase (not more than 2 mm.) it is not often seen. It is frequently the case that medusæ of only one sex are found, having been produced from a polyp of the same sex. For this reason it has been difficult to obtain the fertilised eggs, but Payne (1926) found medusæ of both sexes and succeeded in growing the polyp from the egg. Dr. Dejdar has himself carried on important researches connected with this interesting animal, and now brings together the results of all workers. The anatomy, physiology, reproduction, ecology and systematic position are all fully discussed.

Bark Disease of Beech. The National Research Council of Canada has recently issued (June 1934) a special number of vol. 10 of the *Canadian Journal of Research*, devoted to the beech bark disease. The author of this memoir, Mr. J. Ehrlich, discusses the distribution of the disease in Europe and North America. Under North American conditions the malady begins with the infestation of the bark by

a minute and very common scale insect, *Cryptococcus fagi*, Baer. The insect feeds by inserting its stylet-like mouthparts into the bark and through to the underlying cortex and phloem. Saliva is injected into these punctures and protoplasmic contents withdrawn. When populous colonies of the insects feed in localised areas, whole clusters of parenchyma cells are killed. These clusters dry and shrink, leaving fissures which are readily invaded by the fungus *Nectria*. The actual specific identity of this organism presents great difficulties and has not so far been determined beyond the fact that it is a close relative of the common *N. coccinea*, Pers. A full illustrated account of the fungus is given together with a description of the structure and biology of the scale insect with which it is so intimately associated. While the *Cryptococcus* is the initial essential agent, it alone does not cause disease. Inoculations of clean intact bark failed to produce fungal infection, but similar inoculations on mechanically wounded and on *Cryptococcus*-infected bark produced infection. The disease can be controlled on ornamental trees by early eradication of the insect by means of insecticides. Control in forest stands should aim at removal of infected and dead timber. Attempts to control the scale insect by fungal and insect enemies is suggested, while the planting of beech on broad ridge-tops rather than steep slopes is advised. The culling of larger trees in an attempt to produce changes in the environment designed to restrict activity of the pathogens and the substitution of a younger, less susceptible stand are also recommended.

Leaf-Shape Inheritance in Cotton. In an extensive investigation of the inheritance of leaf-shape in Asiatic cottons, Dr. J. B. Hutchinson (*J. Genet.*, 28, No. 3) has reached some interesting conclusions. Using length-breadth indices for the lobing of the palmate cotton leaf, he finds that the leaf-shapes are controlled by a series of five multiple allelomorphs. A strain of *Gossypium arboreum* known as Burma Laciniated gave a number of bud mutations which bred true from seed and were of two types, with broad and intermediate lobes respectively. The rate of mutation was studied, and a fifth gene—recessive broad—was also used in the crosses. This leaf-shape locus shows linkage with brown tint, giving 30 per cent of crossing-over, and there is also linkage with seed weight and lint percentage, while corolla colour is independent. All varieties of *G. herbaceum* carry the gene for recessive broad lobes. Minor genes are also present affecting leaf size, lobe shape and rumpling, while lint characters are affected by a number of small genes scattered through the chromosomes. In a detailed discussion of the allelomorphic series of factors for leaf-shape, Dr. Hutchinson develops a hypothesis of the gene which combines the theory of stepallelomorphism with D. H. Thompson's side chain theory. This conception is then applied to the peculiar conditions of pericarp and cob colour in maize, to the anthocyanin series in cotton and the bar eye scute and reddish α series in *Drosophila*, as well as to the rogues in culinary peas. The investigations on multiple allelomorphs, on mutable genes and on the relations between mutation and crossing-over are all brought under one consistent view by this theory of gene architecture, which is essentially that of a continuous rod containing gene centres, to which are attached a series of episomes the changes of which constitute the passage from one allelomorph to another of the series, the episomes shifting their position in the gene in certain cases.

Brand Canker of the Rose. Brand canker is a rather serious disease of climbing roses. It was recognised in America in 1924, and its outbreaks were so severe that a detailed study of the malady was made by Dr. Cynthia Westcott ("Brand Canker of Rose, caused by *Coniothyrium Wernsdorfii*, Laubert". Cornell Univ. Agr. Exp. Sta. Memoir 153, pp. 1–39, Ithaca, N.Y., Feb. 1934). Brand canker has been confused with stem canker, which latter fungus is caused by *Coniothyrium fuckelii*, a fungus distinct from *C. wernsdorfii*. Symptoms of the brand canker are described in detail. The fungus enters its host through wounds, and infection usually occurs in late winter or early spring; there is no infection in summer. Control of the disease can only be obtained if infected stems are cut away; no benefit has been obtained by spraying or dusting in summer or winter. The disease is not severe if the bushes are left uncovered through the winter.

Periodicity of Earthquakes. The *Publications* of the Central International Seismological Bureau (Ser. A, Trav. Scien., Fasc., No. 10; 1934) contain two brief but interesting papers on this subject. Prof. V. Conrad (pp. 17–18) considers the frequency of earthquakes with deep foci during the years 1919–28. He finds that they are not subject to a diurnal period, and that there is no accumulation of earthquakes about the days of new or full moon. There are some grounds for believing in the existence of a semi-annual period, and this, in the author's opinion, points to rotation of the earth's pole as the cause of such variations. Father Luis Rodès has examined the influence of the moon on the frequency of 2,242 earthquakes recorded at the Observatory of the Ebro (Tortosa) during the years 1914–32 (pp. 87–90). He concludes that there is no definite period connected with the lunar day, but that the distance of the moon has a very marked effect, the number of shocks being 15 per cent higher about the time of perigee than about that of apogee.

The Polar Aurora. The August issue of the *Journal de Physique* contains an account by A. Dauvillier of the auroral work done during the Polar Year at a station at Scoresby Sound in north-east Greenland (70·5° N.; 22° W.). A large number of auroral formations were recorded, the day-to-day variations in intensity were recorded by estimation, and some work was done with a continuous photoelectric recorder. Spectroscopic observation of the 5577 line was often possible even when the sky was clouded. The author ascribes the variations in shape shown by the auroral curtains to turbulence in the ionosphere, probably of electromagnetic origin. He points out that the phosphorescent post-auroral clouds often have very high velocities of the order of a kilometre a second. The contraction of a generalised aurora into arcs and curtains he ascribes to an electrostatic ionic effect analogous to that employed in cathode ray oscillographs, and he points out that this explanation, applied to secondary electrons produced by very penetrating primaries, may account for the occasional appearance of auroral arcs in equatorial latitudes. The primary electrons of low energy can only reach the earth's atmosphere in high magnetic latitudes.

Toxic Effects of Ultra-Violet Radiation. Researches by Dr. Florence E. Meier, bearing on the toxic effects of ultra-violet rays, are discussed in a report by Science Service dated August 22, and are described in a publication of the Smithsonian Institution. The method used was to coat glass plates with a film of living single cell algæ, and project on it a band of ultra-violet radiation which had been separated out by means of a prism. Dr. Meier studied the killing effects of eight different wave-lengths in the ultra-violet range. She discovered that each had its own specific 'radiotoxic spectral emissivity', that is, the minimum quantity that would sooner or later result in death. Each wave-length also had a specific 'radio-toxic virulence' which measures the time required to produce the killing effect. The two qualities do not necessarily vary in the same way. A very small dose of some of the wave-lengths will kill the algæ but may take a very long time to do it. Radiations of other wave-lengths had to be applied in larger doses, but acted quickly when the necessary quantity was reached. To illustrate her point, Dr. Meier used the analogy of poison effects on human beings. Radium paint such as is applied to watch faces may kill in extremely small doses, but death may not ensue for years. A considerably larger quantity of rattlesnake venom is required to kill, but when that quantity is received death ensues in, at the most, a few hours. The wave-lengths studied by Dr. Meier are between 3022 A. and 2536 A.

Crystal Re-orientation of Cold Drawn Wires due to Re-heating. About a year ago, Alkins and Cartwright (*J. Inst. Metals*, **52**, 221–239; 1933) showed that re-heating certain cold-drawn copper wires of high purity at a temperature of 130° C., that is, below the temperature at which annealing sets in, resulted in a small but definite increase of hardness. G. S. Farnham and H. O'Neill (*J. Inst. Metals*, **55**, Advance Copy; 1934) have examined the change of X-ray structure resulting from this low temperature treatment, and have shown that in some silver-free copper wires, the general effect of the re-heating to 130° C. is to reduce the amount of [111] preferment and to cause an increase of [100] preferment. In silver-bearing wires where the low-temperature hardening is small, the changes of orientation, where they occur at all, are only slight, whence it would appear that an explanation of the mechanical effects in terms of such crystal re-orientation has been discovered.

Influence of Pickling on the Fatigue Strength of Duralumin. In order to assist in the detection of flaws due to manufacturing defects or cracking in service, aluminium alloy components are often etched in media which consist essentially of aqueous solutions of caustic soda. In order to determine the effect of this treatment on the fatigue strength, H. Sutton and W. J. Taylor (*J. Inst. Metals*, **55**, Advance Copy; 1934) have carried out tests on duralumin which has received a normal pickling treatment, and shown that the fatigue limit may be reduced by as much as 31 per cent. This effect is clearly due to some surface condition and may be reduced either by the immersion of the part in boiling water, or by machining off a layer 0·0025 inches thick. In an attempt to devise a treatment which may be employed without the loss of fatigue strength, they have shown that the following procedure reduces the fatigue limit by 6 per cent only, and that subsequent immersion in boiling water lowers the loss of strength still further. The part is first immersed in boiling water, and transferred immediately to a bath containing four parts of 10 per cent sulphuric acid by volume to one part of hydrofluoric acid. A period of immersion of three minutes is used with constant agitation, after which the sample is rinsed in cold water and immersed for one minute in cold 50 per cent nitric acid. It is finally rinsed in cold water, washed in hot water and dried.

Chemical Linkage. Prof. R. F. Hunter and Dr. R. Samuel have contributed to the August issue of the *Journal of the Chemical Society* a critical review of theories of valency on the basis of wave-mechanics and band spectra. Their chief conclusions appear to be that whilst "Lowry's view that a semi-polar bond consists of a covalency and an electrovalency is not excluded by wave-mechanical principles in the present stage of knowledge," "it can be shown that a single electron does not possess bonding power, since the formation of the hydrogen molecule ion $[H_2]^+$ . . . depends essentially on the identity of the two positive nuclei and this case has therefore nothing to do with ordinary chemical linkage." The paper is too condensed to include a full demonstration of the basis for the assertions now made, and most of these should be regarded as merely tentative, since it is not yet clear that they will 'hold water' when subjected to a critical examination. Thus the equivalence of the two oxygens in the nitro-group is certainly not 'established' by the zero dipole moment of *p*-dinitrobenzene, since this equivalence may be merely statistical; and on the other hand, further evidence will be required before an unsymmetrical structure for the oxygen molecule need be admitted. Incidentally, the authors deny the existence of the BF_4^- and SiF_6^{--} ions, except as dipole aggregates, although in the latter case their conclusion is in flat contradiction to the generally accepted deductions from crystallographic evidence. The paper is therefore obviously provocative of discussion, but its influence on current theories of valency seems likely to be of a polishing, and not of a shattering, character.

Origin of the Galactic Rotation. The fact of the rotation of our galaxy is now comparatively well established, and is a property also possessed by other external systems. The origin of these rotations has been discussed by Dr. G. Strömberg (*Astrophys. J.*, **79**, 460). It is traced back to the time when the systems were recently formed, and not very widely separated; close encounters of two systems producing the initial rotation through tidal forces. Large angular momenta would be produced in this way, but only small angular motions. During the process of contraction, however, the linear and angular velocities would increase, thus accounting for the rapid rotations now observed. In the case of our own galaxy, the encounter must have occurred before any very dense condensations had formed. The only individual dense objects which might have existed would be those which have developed into cluster-variables, long-period variables, and others of very high velocity. It is suggested that planetary systems like that of the sun might have been similarly formed, in which case they would probably be rather common in the galaxy, and not (as usually believed) very exceptional phenomena.

Reduction of Traffic Noise

ON September 10, in Section G (Engineering) of the British Association meeting at Aberdeen, Sir Henry Fowler presented, as chairman, the report of the Committee on Reduction of Noise, and thus introduced a series of papers on the subject. This Committee has analysed a large number of letters from members of the public concerning the noises which cause them most discomfort and inconvenience, and has reached the conclusion that the sources which cause most annoyance are, in turn, inadequately silenced motor-bicycles and 'sports'-type motor-cars, motor-horns, other road transport noises and aircraft. No other cause produces half the complaint levelled against the latter source. Realising that the Air Ministry is doing everything possible to reduce aircraft noise, the Committee has devoted its attention first to the exhaust noises of motor-bicycles and sports-cars and, with the help of a donation of £50 from Lord Wakefield, an investigation of silencers was carried out at University College, Southampton. In order to assist in the establishment of an authority to which types of motor-vehicle could be submitted for test of approved silence, the Committee arranged for a critical review of the methods available for measuring noise, particularly noises of a given type, such as exhaust noises. Arrangements were also made for a firm manufacturing motor-horns to give a paper examining characteristics which render a signal effective as well as those which cause it to be offensive.

Dr. E. O. Turner, of Messrs. Joseph Lucas, Ltd., described and demonstrated various horns at the meeting and at open-air tests. He considers that expedients suitable for further consideration are that horns should give a strictly periodic note without appreciable delay when operated; that the note should have a fundamental of low pitch with one or more strong overtones, the highest not exceeding 3,000 cycles per second, the loudness not exceeding a prescribed figure; that auxiliary horns of higher pitch and greater loudness might be fitted to motor-vehicles, but for country use only, and that single staccato signals should be employed wherever possible instead of sustained notes.

Wing Commander Cave-Brown-Cave outlined the experiments which have been carried out at Southampton, in attacking the problem of silencing the exhausts of motor-bicycles. He reviewed recent work on exhaust noise, and ascertained with the assistance of the Motor Cycle Manufacturers and Traders Union the maximum size acceptable for silencers intended for motor-cycles. After experiments in which the back pressure on the engine and the power developed were measured, he has evolved silencers for representative 2-stroke and 4-stroke machines which gave adequate silencing without obstructing the flow of exhaust gases, and thus without causing loss of power. These silencers consist essentially of two lengths of absorption silencer in series with two small expansion chambers, the whole being compactly contrived in an outer casing of convenient size. The absorption silencers consist of a perforated pipe surrounded with one of larger diameter. In some cases, the interspace is packed with absorbing material such as glass silk, and in others the packing is omitted and the perforations are in the form of lipped holes resembling those used in nutmeg graters.

Demonstrations of the effectiveness of the silencers were given at the meeting and on a hill near the Brig o' Dee, where 2-stroke and 4-stroke motor-cycles fitted with various standard and "B.A." silencers were demonstrated.

Dr. A. H. Davis, of the National Physical Laboratory, in discussing noise measurement from the point of view of tests of approved silence, dealt particularly with the accuracy and validity of various methods. Aural methods of loudness measurements necessitate the averaging of the results of several observers in order to get a typical result with the precision that is likely to be called for in testing machines to specification. Moreover, aural results will always be open to suspicion of personal bias. Objective instruments can be constructed, however, which, in suitable cases, will give a meter reading corresponding to the average aural judgment. Such instruments are not wholly rigorous in their theoretical foundations, but the more serious difficulties are known and appear to have been overcome. In fact, objective meters have been used successfully for measuring moderate and loud sounds of varied character, and have even proved more reliable than individual hearers in assessing average judgments as to relative loudness. The demands upon the objective meter are, however, minimised if the sounds concerned are of similar character and of the same order of loudness, so that properly designed meters may certainly be expected to indicate whether or not a device of a given type (say, exhaust or motor-horn) is louder than a standard device of the same kind. At present, however, preliminary test of any particular meter is desirable upon the type of noise concerned.

Dr. Davis later demonstrated, at the motor-cycle silencer trials, a noise-measuring instrument of his own design which is in use at the National Physical Laboratory; this gave indications in the trial which were believed to be in agreement with the general impressions of the order of loudness of the silencers concerned. The loudness at the roadside, under the conditions of the test, of the unsilenced 4-stroke motor-cycle, was about 106 phon, and this was reduced on an average to 93 and 87 phon respectively when standard and "B.A." silencers were fitted; a rather larger "B.A." silencer gave further reduction, to 84 phon. Conditions (speed, throttle-opening, etc.) were maintained as constant as possible during the tests, but closer control would be necessary to differentiate between exhaust systems differing in loudness by only one or two phon. In the case of the 2-stroke motor-cycle, the loudness unsilenced was about 100 phon, a level which was reduced to 82 phon and 75 phon respectively when standard and "B.A." silencers were fitted. An improved (1934) Standard silencer was in this case almost indistinguishable in loudness from the "B.A." silencer.

It may perhaps be now inferred that appreciable silencing of motor-cycles can be achieved. It also appears that if manufacturers or appropriate authorities desire to fix limits to the permitted noisiness of machines or of motor-horns, some standardisation would undoubtedly be necessary of the conditions and surroundings under which the machines or horns are to be tested, but that it is now within the scope of well-designed physical noise meters to make the necessary measurements. A. H. D.

Astrophysics at the Royal College of Science*

TRIBUTE TO PROF. A. FOWLER

FOR more than fifty years Prof. Fowler has been associated with the work of this College. For the greater part of that time he has been one of its leading figures ; and now the time has come for that long association to cease. On such occasions as this it is customary—and it is well—to practise some dissimulation. If we were to express the feelings that lie nearest our hearts, we should not feast, but fast :

"Make dust our paper, and with rainy eyes
Write sorrow on the bosom of the Earth."

But the age of realism in such things has yet to come. If the future is dark, we look towards the past and draw comfort from the thought that much that has been done survives and will survive in the days to come. In the career of Prof. Fowler there is special warrant for that reflection. When we look back at the long history of things of great value done supremely well, we are not only assured of their permanence ; we are also held by the romance of their achievement.

We of this generation are inclined to look upon the period about the year 1895 as marking the renaissance of physical science from a state of stagnation—a state in which, as it has been said, it seemed that nothing remained to be done but to add a few more decimal places to the values of well-determined constants. That is not altogether a true picture. In the mind of one man, at least, the morning twilight of the new day shed its light long before the sun rose. At the Normal School of Science, which we are proud to claim as our ancestor, Norman Lockyer was making those researches into spectrum analysis and building those seemingly fantastic theories which to his contemporaries were either stumbling-blocks or foolishness, according to their nature, but which we recognise as the authentic herald of the physics of to-day. Lockyer could not convince the mature, but he could inspire the young ; and in 1882 there came to his lectures a very young student, with more than ordinary ability, with all the enthusiasm of youth, and with the potentialities of a boundless loyalty waiting to be claimed. The sequel was inevitable. Lockyer was not only a pioneer in science, he was also an organiser of the first order ; and to that genius which gave the world its foremost scientific journal came its other great inspiration. In 1886, Alfred Fowler became computer to Prof. Lockyer.

It was my privilege a few years ago to be given access to Lockyer's papers. The name of Fowler does not often appear, but when it does the references are significant. "My excellent assistant Mr. Fowler." "Mr. Fowler did his eclipse work admirably." Whenever a piece of research depended on a crucial observation, that observation was invariably Mr. Fowler's. In scanning the records one became conscious of a dim Presence haunting the background, always ready to interpose at the difficult minute—the sort of figure of which legends are made, like some shadowy Siegfried supporting the arms of the visible hero.

In the year 1901, Lockyer retired from the Royal College of Science, taking his laboratory equipment with him into the Solar Physics Observatory, of which he retained the directorship, and Mr. Fowler was left in charge of what astrophysics remained in the College. To one who knows the Astrophysics Department only as it is to-day, its beginning at that time is scarcely credible. Mr. Fowler's laboratory was a table in a frequently used lecture theatre, in a corner of which a dark room had somehow to be improvised. For apparatus he had one small spectrograph, of a type which we should now consider suitable for a promising child's stocking at Christmas ; and for encouragement the collected indifference of most of those who might have been concerned. In such circumstances was begun that remarkable series of researches which lie at the basis of modern physical astronomy—the identification of the bands in the spectra of red stars ; the detection of magnesium hydride and other compounds in sunspots ; the solution of the problem of comet-tail spectra ; the laboratory production of 'cosmic hydrogen' ; and the many contributions to the experimental foundation of spectroscopy which have made our Astrophysics Department a goal of pilgrimage from all the continents of the earth. All the world knows these things ; but he only knows the difficulties and the disappointments that beset their accomplishment.

My own acquaintance with Prof. Fowler began in the early days of the War, when his supremacy in all branches of spectroscopy was already established, and the new Bohr theory was making it manifest to all. To me, as a student, he was a great man by natural right. He belonged to the hierarchy of professors, who had not experienced the difficulties of us lesser minds, but had always lived aloft in inaccessible greatness. You can imagine my surprise when he came into the laboratory and joined in the elementary instruction, turning globes and adjusting spectroscopes with more skill and almost as much assurance as a first-year demonstrator. He didn't shirk questions : he invited them ; and the familiarity with the workings of Nature which he showed led us to sympathise with the error of the young lady who construed the arrow with the word "Wind" on the driving-clock of the telescope as his instruction to the wind to blow that way.

One of his rare errors of judgment occurred just after the War, when he asked Prof. Callendar for my services as demonstrator. There was no competition, and the request was granted. Another junior member of the staff said to me : "Why are you going into astrophysics ? That's a side-line. You would do better to stick to general physics, and keep out of that narrow groove." But for my part I was pleased. The subject certainly had attractions, but to me it was not so much astrophysics as Fowler's Department that I was entering ; and I soon found that, so far from entering a narrow groove, I was receiving a more than liberal education. We were a centre to which men of all types converged —astronomers with impossible theories to be made plausible ; archæologists with specimens to be tested to discover whether the Sumerians could make bronze ; nurses asking if their foods contained enough vitamins to build bonny babies ; psychologists looking for differences between the spectra of human

* From a speech by Dr. H. Dingle at a complimentary dinner to Prof. A. Fowler, at the Imperial College Union, on Oct. 9 (see NATURE, Oct. 13, p. 562).

and animal souls: we were an encyclopædia for poets searching for spectroscopic metaphors; a hospital for ideas battered by the shocks of criticism; a home for the consolation of lost causes and the triumph of successful ones: people of all trades, professions, races, nationalities, sexes, ages, religions—great men, small men, lean men, brawny men, brown men, black men, grey men, tawny men, grave old plodders, gay young friskers—all came for advice to this narrow specialist, and went away, if not always satisfied, at least convinced that nothing further could be done along that line.

All this is now ended, but we have one consolation, and a great one. When Persephone was taken by Pluto from the fields of Enna into the shades below, she was permitted to return once a year for the comfort of those who were left behind. Prof. Fowler is not going into the shades: he is leaving the visible spectrum, but there is a whole octave of ultra-violet to be traversed before the vacuum region is reached. And whatever god presides over the land in which he chooses to dwell, he goes on the condition that, not merely once a year, but whenever instinct tells him that he is needed, he is to be allowed to revisit the glimpses of the arc and the spark and the vacuum tube; and I for one shall listen daily for the familiar footstep. When it comes a drawer will be opened, and out will come the problems and the difficulties that have been put aside to await the coming of the master.

Fluorescence Microscopy and its Application to the Identification of Fibres

ONE of the most recent and interesting applications of ultra-violet light as a testing method is its use as an aid to microscopical work. Since it is well known that structures visible to the naked eye show distinguishing features in ultra-violet light which are invisible in ordinary light, it is not unnatural that the application to microscopic structures of the same principle should have been attempted. As already indicated[1], this method has met with considerable success, notably in the examination of sections of botanical specimens such as seeds, tissues, etc., the best results being obtained in cases where the individual details of the structure fluoresce differently. Starch and fatty matters, for example, fluoresce vividly and stand out in sharp contrast, and a notable case is that of cacao, in which the shell tissues and mucilage cells may be distinguished in this way.

The method has now been carried a stage further by the use of fluorescent materials as stains, and this has opened up many promising lines of advance in microscopical technique. It is obvious that if the dyes used for selective staining in ordinary microscopical work are supplemented by substances which cause a particular detail of the structure to fluoresce with a specific colour in ultra-violet light, then many strings will be added to the bow of the practical microscopist. Fortunately a large number of such substances (usually dyes) exist, and only await investigation.

The apparatus required for this work is by no means elaborate. A good microscope and a source of ultra-violet light are of course essential, and in connexion with the latter there seem to be differences of opinion among various workers as to which type gives the best results. All would probably agree, however, that a brilliant point source is desirable, so that the mercury vapour lamp in the form most familiar to workers in Great Britain is by no means the ideal. Successful results have, however, been obtained with arcs struck between iron, cadmium, magnesium-carbon and nickel-carbon electrodes.

The lens system on the arc side should be made of quartz on account of the absorbing powers of ordinary glass for ultra-violet light. This applies to the converging lens and condenser used to concentrate the light on the microscope mirror, and in addition it is desirable to insert filters to remove visible and infra-red rays, so that the radiation finally obtained covers the range 3,000–4,000 mμ. Numerous commercial filters are available for the former purpose, and for the latter a cell containing a solution of copper sulphate is very convenient. Since the microscope is used only for the observation of effects produced by visible light, ordinary glass lenses may be used, and if the fluorescence is sufficiently bright, these are satisfactory even for colour photography.

Useful adjuncts in this work are devices for dark-ground and surface illumination. The Lieberkuhn mirror and other lens systems used for the latter purpose give very striking results which are quite different from those obtained by transmitted light; the self-luminosity of fluorescent structures also enables vivid effects to be obtained with dark-ground illumination. In some cases, it is an advantage to bed the specimen in a mounting medium, and the selection of the medium should be then governed by the nature of the specimen. Thus both Canada balsam and paraffin wax themselves fluoresce, but whilst in some cases the emission of light masks the fluorescence of the structure, in others it may be used to throw dark structures into relief. A speck of quinine placed on the slide is a great aid in focusing, as it is highly fluorescent.

Even under the above conditions, a certain amount of ultra-violet light may still reach the eye, and it is therefore advisable for prolonged work to wear protecting goggles in order to avoid the possibility of conjunctivitis. Special cover-slips which are opaque to ultra-violet light are an additional precaution and serve the further purpose of eliminating any fluorescence produced by the action of the rays on the lens system. For work with transmitted light, a quartz prism or a silver reflector is used in place of the microscope mirror, and the slide must, of course, be made of quartz; glycerol should replace cedar wood oil for 'oil' immersion lenses.

Some of the most interesting advances in this work have been made in connexion with fibre analysis, and in particular with that branch of the subject which is the concern of the cellulose industries. A number of ordinary stains are already in continual use in this connexion, but they suffer from several defects, notably that they are difficult to prepare in a sensitive form, and that their applications are limited. F. Noss and H. Sadler[2], however, have examined the suitability of a large number of dyes from the point of view of fluorescence microscopy, and find that in particular, a 0·05 per cent solution of rhodamine-6 *G-D* has useful properties. Thus, fibres prepared by the sulphite process appear yellow, whilst sulphate pulps give an orange-red colour; if the fibres have not been bleached the colours assume a brown tinge. Since the vivid blue fluorescence of unstained, unbleached wood fibres is a well-known phenomenon,

it is therefore possible first to determine the amount of this material present and then, by staining, to ascertain by what process it has been prepared.

This work has more recently been taken up and extended in a series of publications by B. Schulze and E. Göthel[3]. They also examined a large number of dyes and confirm the suitability of rhodamine and eosin, and in addition, recommend sulphorhodamine-*G* and certain of the flavophosphines; the former may be used to distinguish unbleached soda pulp from bleached soda and sulphite pulps, in the absence of unbleached sulphite pulp. Brilliant dianil green was also found to be a useful aid to the distinction of summer and spring woods, with which it gives a blue and yellow colour, respectively. Adansonia (light blue) could be differentiated from manilla and jute, and diagnostic details of other unusual fibres such as Gampi, Mitsumata and Kodzu were also obtained; in some cases these methods have been developed quantitatively. A word of caution seems desirable in connexion with the use of rhodamine-6-*G* for fluorescence experiments, as the writer has found that dyes from different sources sold under this name may give entirely different effects; this indeed may explain the failure of Schulze and Göthel to confirm some of the results of Noss and Sadler where this dye has been involved.

Reference should also be made to the work of E. Grünsteidl[4] in which similar principles are applied to textile fibres. The primary fluorescence of such fibres, that is, the fluorescence obtained in the unstained state, is itself of value for diagnostic purposes, raw cotton being bright blue (dull grey if mercerised), whilst various silks (real and 'artificial') may be differentiated if examined under controlled conditions. The use of dyes and stains, however, and in particular of quinosol followed by alkali, has proved an additional aid; for example, linen then appears yellow and cotton violet. Similarly A. Segitz[5] records the use of extract of spruce bark for the differentiation of materials of the "Cellophane" type.

These examples are necessarily restricted in use and as yet incompletely investigated, but they at least serve to illustrate the possibilities awaiting investigation in this field. J. G.

[1] NATURE, **133**, 124, Jan. 27, 1934.
[2] *Pap. Fabrikant*, **31**, 413; 1933. Korn, *ibid.*, **32**, 181; 1934.
[3] *ibid.*, **32**, 110; 1934. *Zellstoff Pap.*, **14**, 93; 1934. *Woch. Pap.*, No. 7; 1934.
[4] *Faserforschung*, **10**, 215; 1933. *Rayon and Melliand Text. Month.*, **15**, 88, 93; 1934.
[5] *Pap. Fabrikant*, **28**, 206; 1930.

Microplankton and Hydrography of the Great Barrier Reef*

MISS S. M. MARSHALL, in her contribution to the Scientific Reports of the Great Barrier Reef Expedition, describes the production of microplankton in the Great Barrier Reef throughout the year. This is the first time that an opportunity has occurred of obtaining continuous observations in one place for so long a time in these regions. The results of the work carried on in the lagoon of the Great Barrier Reef enables a comparison to be made between the conditions in the tropics and those in temperate waters. The water samples used were from various depths, forming part of the routine work at the plankton and hydrographic stations taken by the Nansen-Petterson water bottle. Outside samples were also taken with a glass sample bottle. The material was centrifuged and counted (100–200 c.c. of each sample). Most of it was examined when fresh, thus allowing the small naked dinoflagellates and coccolithophores to be included; the remainder was preserved in strong Fleming solution.

The organisms were grouped so far as possible in their genera. Neritic forms are predominant as was to be expected, especially among the diatoms, which were the most important group. Dinoflagellates and coccolithophores occurred in fair numbers, the latter restricted to water of high salinity. Pennate diatoms were unexpectedly numerous inshore, most of them being bottom forms stirred up from below.

The chief feature of the Great Barrier Reef plankton is that there is no special seasonal maximum and minimum; it is maintained at much the same level throughout the year. This is strikingly different from the conditions in temperate waters where one or two maxima constantly occur, the phytoplankton maximum being followed by a zooplankton maximum. Miss Marshall finds no real seasonal change in the composition of the diatom flora. Large increases sometimes occur, but not regularly. In the lagoon the wind keeps the water thoroughly mixed from top to bottom. The nutrient salts estimated were present only in very small quantities throughout the year and no relation was found between them and the diatom or dinoflagellate abundance. The type of plankton production found, the numbers low and varying little during the year, depends largely on physical conditions.

Trichodesmium occurs in large patches at irregular intervals, being most abundant in the calmer months from October to February. On August 22–25 large patches drifted on to the reef causing great distress to the fishes in the moats, and eventually decayed along the shore. In Mr. Orr's report (No. 4*a*), it is stated that at this time, because of *Trichodesmium*, although the water had been supersaturated with oxygen just when the tide left the reef flat, it was completely denuded of oxygen before the tide re-entered. Only pools in which the blue-green alga was deposited in quantity and decomposing showed this absence of oxygen. On no other occasion was a value below saturation with respect to oxygen found during the day on the flat.

The changes in temperature, salinity, oxygen and *p*H value among the coral reefs are specially described and vary enormously, both daily and according to season. These changes may have an important effect on the reef organisms. Tidal and diurnal changes are on the whole more important than seasonal changes. The greatest differences occurred in coral pools isolated at low tide either during the night or during the day, the water being usually supersaturated with oxygen during the day and undersaturated at night.

In the mangrove swamps (No. 4*c*) the diurnal and seasonal changes are greatest at spring tides and are greater in summer than in winter. There are diurnal fluctuations in temperature, salinity, *p*H value and oxygen content in the mangrove swamps on Low Isles reef flat and usually a night fall and a day rise in temperature: salinity rises at low tide whilst *p*H value and oxygen saturation fall.

*British Museum (Natural History). Great Barrier Reef Expedition 1928–29. Scientific Reports. Vol. 2. No. 4. (*a*) "Variation in some Chemical Conditions on and near Low Isles Reef". (*b*) "The Temperature of the Waters in the Anchorage, Low Isles". (*c*) "Physical and Chemical Conditions in the Mangrove Swamps". By A. P. Orr and F. S. Moorhouse. No. 5. "The Production of Microplankton in the Great Barrier Reef Region". By Sheina M. Marshall. 1933.

University and Educational Intelligence

CAMBRIDGE.—The Gedge Prize for 1934 has been awarded to J. S. Turner, of Selwyn College.

Two lectures will be delivered by Prof. J. Schouten of the Technical High School, Delft, on "Projective Relativity". They will be delivered at 5.30 on October 23, and 4.30 on October 24 in St. John's College.

In connexion with the visit of His Majesty the King to open the new Library on October 22, it is proposed to confer the honorary degree of Sc.D. on Prof. L. J. Henderson, professor of biological chemistry at Harvard University and upon Dr. Karl Landsteiner, member of the Rockefeller Institute for Medical Research.

Dr. F. Kidd, St. John's College, has been appointed superintendent of the Low Temperature Research Station in succession to the late Sir William Hardy.

At Trinity College, M. Black, University demonstrator in geology, has been elected to a fellowship.

OXFORD.—In his oration delivered on the termination of his second year of office, the Vice-Chancellor dealt with several matters of scientific interest. After noticing the completion of the extension of the Radcliffe Science Library, which is to be opened for use on November 3 by the Princess Royal, he reported the successful setting up of the new solar telescope, with its accessory apparatus, under the skilful direction of the Savilian professor. Permission, subject to certain conditions, has been granted to the Radcliffe Trustees to establish an observatory in South Africa. Future developments of the means for scientific study will be carried out as soon as the necessary funds are forthcoming. Among these are the extension of the Lewis Evans collection into a museum of the history of science, the further endowment of the Department of Anthropology, an addition to the staff of the Hope professor of zoology, and further provision for the teaching of embryology and neurology. Several of these are regarded as urgent, but, for the time being, impracticable.

WALES.—It was announced at a meeting of the Court of Governors of University College, Cardiff, that the college has received a gift of £23,000 "from a generous donor and old friend of the college". The number of students in residence during the current session is 1,347. The figure shows an increase of 24, as compared with last year, in spite of new restrictions on the entry of medical students, and those in receipt of Board of Education grants.

On October 12, Sir William James Thomas officially opened the new laboratories of materia medica and pharmacology in the Department of Preventive Medicine at the Welsh National School of Medicine.

THE following awards of the Institution of Naval Architects have recently been made: Vickers Armstrong scholarship in naval architecture (1934) of the value of £150 a year for four years at the University of Glasgow to Mr. Gordon S. Milne, of Messrs. Hall Russell and Co., Glasgow; Duke of Northumberland prize (in connexion with the 1934 examinations for National (Higher) Certificates in naval architecture) to Mr. William P. Walker, of the Royal Technical College, Glasgow.

Science News a Century Ago

Diseases in Potatoes

In the early part of 1834, the Highland Society of Scotland (now the Highland and Agricultural Society) offered a premium of ten sovereigns "for the best essay on the nature and causes of the injury or disease of the Potato and on the best means of preventing or palliating it in future. . . . The attention of the writer is especially directed to the probable existence of insects in the sets or tubers, and if such have been detected, he is required to give a description of them and if possible, to transmit with his Essay, specimens of the insects". The essays had to be submitted before October 20, 1834, and some twenty competitors took part. The premium was offered because of the failure of the potato crop in Great Britain in the previous year. Various organisations interested themselves in the problem—notably the Highland Society and the Royal Dublin Society. The general conclusion arrived at was that the failure was due to the drought of the summer of 1833, as a consequence of which the crop was harvested very early, and in an immature condition. It is interesting to note that it was agreed that "the plant itself does not appear to have become materially deteriorated by having been so long in cultivation".

The North-West Passage

In 1833, Admiral Sir George Back (1796–1878), then holding the rank of commander, was sent out with an expedition to obtain information about Capt. John Ross, who had been in the north since 1829. On October 23, 1834, the *Times* said that "Letters from Captain Back were received yesterday morning at the office of the Royal Geographical Society the latest date being the 29th of April last, when the intelligence had just reached him of Captain Ross's return". Their contents were of a mixed character. He and his party were all well with the exception of Augustus, the Eskimo interpreter who had accompanied Sir John Franklin in both his journeys, but who had died on his way to join Back's party. The expedition had experienced a most distressing winter and many of the unhappy natives had fallen victims to famine in situations the most revolting to human nature. In a private letter, Back said, "My day is chiefly spent thus—before breakfast I read a portion of Scripture, and afterwards attend to my observations, study, draw (I have plenty of pencil sketches), work up my survey, take notes on Aurora, etc. At the same time I keep my eye upon whatever duty is going on, have an evening school twice a week, and read the service in French and English every Sunday. My guitar is cracked and jars abominably, but you will not be surprised at this when I add that I have been obliged to grease my hands daily to prevent their cracking also, for such is the dryness of the atmosphere that nothing can stand it." Back's expedition was notable for the discovery of the Great Fish River.

Hancock's Steam Carriages

Of the various projectors of steam road carriages, none came nearer commercial success than Walter Hancock (1799–1852). On October 25, 1834, the *Mechanics' Magazine* published a communication from him entitled, "A Statement of the Performances of the Autopsy and Era on the Road between London

and Paddington, from the 18th August to the 11th October, 1834", in which he gave some particulars of the defects which had occurred in those steam vehicles, and the difficulties which had arisen from the bad state of the roads. "I have up to this time," he said, "carried nearly 4,000 passengers in perfect safety, and I am happy to say that the Jehus of the road get more friendly and reconciled to us; and as it is my intention to employ steady coach drivers as steersmen the sooner this feeling is fully developed the better. Why should there be the least ill-will? What difference can it make, whether they drive horses or

" 'Sweep o'er the hills in the glory of steam'."

Societies and Academies

PARIS

Academy of Sciences, September 3 (*C.R.*, **199**, 545–560). K. ZAREMBA: An extension of the idea of the differential equation. ROLF NEVANLINNA: A general principle of analysis. ED. LE DANOIS and L. BEAUGÉ: The relief of the edge of the continental plateau to the west of the entrance to the English Channel. A chart of the western entrance to the Channel is reproduced showing the extreme complexity of the relief of the continental edge. The hydrographical work upon which this chart is based was carried out with the Marti self-recording sounding apparatus, supplemented and confirmed by the Langevin-Florisson apparatus. QUIRINO MAJORANA: A new interference apparatus. This consists of a slit and a prism of very small angle, about 1°: the author calls it the monoprism and outlines some of its applications. JEAN RATELADE: The rhythmical precipitation of silver chromate in "Cellophane". CHARLES COURTOT and JOSEPH FRENKIEL: The phenyltolyl- and ditolylsulphinones.

September 10 (*C.R.*, **199**, 561–592). CHARLES RICHET: Anaphylaxy in therapeutics. Medical and therapeutic treatments ought to be brought into relation with toxic actions of which they are only the first stage. Certain observations have proved that the repetition of a dose originally inactive has a therapeutic effect. HENRI ADAD: Researches on surfaces several times encircled. CHARLES PLATRIER: The small elliptical vibratory movements of the most general homogeneous material medium. M. DODERO: The preparation of cerium silicide and lanthanum silicide by igneous electrolysis. The cerium silicide $CeSi_2$ can be obtained by the electrolysis of small quantities of cerium oxide in baths of calcium silicate, at relatively low temperatures (1,000° C.). Substitution of the cerium oxide by lanthanum oxide gives the silicide $LaSi_2$, not hitherto described. MME. ANNE JOFFÉ and A. JOFFÉ: The spectral distribution of the photoelectric effect in cuprous oxide. From the observations of the author and of other workers it is concluded that the photoelectric effect of cuprous oxide or of selenium is due to the reduction of resistance produced by the illumination of the thin arresting layer. E. DUCHEMIN: The magnetic susceptibility of some hydrates of magnesium sulphate and of some salts of the magnesium series. Measurements of magnetic susceptibility lead to the conclusion that the salts $MgSO_4$, H_2O and $MgSO_4, K_2SO_4$ are unstable complex compounds in the solid state. The first of these remains a complex compound on hydration but the latter is converted by addition of water to molecular combination. M. BOBTELSKY and B. KIRSON: Reaction of complex salts of copper on the decomposition of hydrogen peroxide. ED. CHAUVENET and MLLE. J. BOULANGER: The combinations of zirconyl iodide and the alkaline iodides. From the results of a thermochemical study the existence of the following compounds is deduced, $ZrOI_2.KI$, $2ZrOI_2.RbI$, $2ZrOI_2.CsI$, and $2ZrOI_2.NH_4I$. There was no evidence of the formation of similar compounds with lithium and sodium iodides. PAUL BASTIEN: The properties of sublimed calcium. A comparison of the properties of resublimed calcium (99·3 per cent calcium) with two commercial specimens (98·6 and 93 per cent). ROBERT DELAVAULT: The mechanism of oxidation of alloys of magnesium and of calcium at a high temperature. PIERRE LAURENT: The use of the specific inductive capacity in the study of reactions in organic solution. ROGER PERROT: The action of nitrosyl chloride on some aromatic nitriles. RAYMOND-HAMET and L. MILLAT: A new alkaloid from *Mitragyna*, mitrinermine. The bark from *Mitragyna inermis* is used by certain tribes in tropical Africa as a febrifuge. A crystalline alkaloid has been extracted from this bark, of the composition $C_{22}H_{28}N_2O_4$. P. ZÉPHIROFF and MME. N. DOBROVOLSKAIA-ZAVADSKAIA: A liposoluble œstrogenic substance isolated from spontaneous mammary tumours of mice.

CAPE TOWN

Royal Society of South Africa, June 20. A. OGG, E. N. GRINDLEY and B. GOTSMAN: Diurnal and secular variations of the earth's magnetic field at Cape Town. In a former communication (*Min. Proc.*, October 18, 1933), the monthly means of the declination and the secular variation (+ 4·2′) for August 1923–33 were given. The mean variation from seven such determinations extending to February 1933–34 gives for all days of the month a value of + 3·8′ (that is, to the east). This determination that the secular change of declination in this latitude is of the order of + 4′ is of importance since magnetic tables gives the value + 10′ for the epoch 1925. A Fourier analysis of the declination referred to meridian 18° 30′ E. gives a good agreement between corresponding months of the year. From the above data the secular variation of the horizontal intensity is − 97 gamma, probably the largest secular variation at any point on the earth's surface between the latitudes 60° N. and 60° S. R. S. ADAMSON: The vegetation and flora of Robben Island. I. DONEN: Studies in deciduous fruit: the effect of time of picking on the keeping quality of plums, with especial reference to the internal browning of the Kelsey plum. Plums were chosen from four orchards differing in soil, climate and cultural treatment, kept at 34°–36° F. for 30 days and at room temperature for four or twelve days, and percentage breakdown recorded. Kelsey plums in store exhibited two types of breakdown: internal and invasive browning. The extent of browning is associated with the amount of skin colour of the plum on picking. For export, they should be picked with 5–8 per cent colour and should not be kept in store for periods much longer than 30 days.

GENEVA

Society of Physics and Natural History, June 21. R. WAVRE: Fourier's integrals and the representation of certain multiform harmonic functions. R. MOTTIER:

The oxidation of cod liver oil and a rapid method for determining the antioxygen action of various compounds. A. LIENGME and NICOLE: A new micro-organism pathogenic to man: *Bacillus cysticus fragilis*. The authors have isolated from the urine of a man suffering from slight cystitis a new micro-organism distinguished by various characters from those at present known. A. LIENGME and MLLE. PIQUET: Study on the interferometry of Hirsch. Researches on the presence of a non-specific power of concentration. Researches on the presence of a non-specific power of concentration of the opzims (non-specific value of Durupt) (1). By exhaustion of the power of fermentation of the serum. A first series of experiments tends to show that there does not exist a non-specific power of concentration of the serum by the opzim. A. LIENGME and GOUDET: The proportion of the blood groups at Geneva. Statistics based on 1,000 cases. Group *O*, 40·2 per cent; group *A*, 48·9 per cent; group *B*, 7·9 per cent; group *AB*, 3 per cent. The formula of the blood groups of the Geneva population is nearer to that of France, Belgium and especially Portugal than to that of Germany and even German Switzerland. F. WYSS-CHODAT: (1) Studies on the bacteriophage. Is the bacteriophage of Hérelle a living organism? Result of the study of the flocculation of the bacteriophage and of its sensitivity to some volatile antiseptic solvents. (2) Concerning the food value of milk. J. BUFFLE: A new character of glacier-fed rivers based on the periodicity of the proportion of dissolved matter in the waters of these rivers. Remarks on the proportions of dissolved matter in the waters of the Arve in 1933. CH. E. GUYE: Some properties of the layers of molecular dipoles.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 7). B. HOSTINSKY: A functional equation considered by Chapman and by Kolmogoroff. R. KUZMIN: Roots of the function $\zeta(s)$ of Riemann. N. KOSHLIAKOV: Some integral representations of the square of Riemann's function. V. LEVSHIN: On the connexion between the absorption and luminescence spectra in concentrated solutions of colouring matters. R. JAANUS and V. DROZDZHINA: The state of the cerium atom inside the metallic lattice. The authors suggest that in cerium metal there exist either one or three 'free' electrons per atom. M. KATZNELSON and I. KNUNIANC: β-quinolylazo-$\alpha\alpha_1$-diaminopyridine and its derivatives. V. SADIKOV and D. MALIUGA: Autoclave splitting of blood albumin with 2 per cent phosphoric acid (1). Isolation of cycloleucyl-leucyproline from ether extract. It has been determined by analyses of the copper salts that the cyclopeptide $C_{17}H_{29}N_3O_3$ gives on splitting two parts of leucine and one part of proline and is therefore a cyclopeptide cycloleucyl-leucyproline. Its structure is given. P. LEBEDEV: Geochemistry of manganese in Western Siberia. The scheme of migration of manganese may be represented as follows. Manganese in pyroxenes and ore formations: gabbro → bivalent manganese in magnetites of iron ore bodies → manganese in the zones of segregation. The last stage of the possible history of manganese compounds seems to be connected with the genesis of quartzite-breccia type of manganese ores. V. KOLESNIKOV: On the Sarmatian fauna in Bulgaria. A. GUBIN: The distribution of bee-keeping in the U.S.S.R. as related to climate. The regions where bee-keeping thrives have 500 mm. or more of annual precipitation, though bee-keeping is practised also in areas with 300–500 mm. precipitation. The northern limit depends on the length of winter, and there are scarcely any bees where rivers remain frozen for more than 180 days a year. G. LINDBERG: Description of a new genus and species *Gobiodonella macrops* (Gobiidæ, Pisces) from Misaki, Japan.

ROME

Royal National Academy of the Lincei, May 20. G. A. CROCCO: The 'focus' of a biplane. A method is given for determining the focus of a biplane, this being defined as the point of application of the resultant of the increments of the aerodynamic forces on the two wings. A. DI LEGGE: Observations of the horizontal diameter of the sun at the Royal Observatory at Campidoglio during 1901–10. The mean of the values obtained by three observers during this decade is 961·39″ (semi-diameter). The mean for the period 1874–1910 is 961·18″, which agrees exactly with the value deduced by Auwers from the observations made at Greenwich during 33 years. V. NOBILE: Utilisation of spectroscopic determinations of the radial velocity in the study of the perturbed motion of stellar systems. O. CHISINI: A theorem of the existence of multiple planes (1). N. SPAMPINATO: A real algebra of four units. R. CACCIOPPOLI: A general theorem on the functions of two complex variables. O. PYLARINOS: The movement of a material point on a fixed conical surface. U. BARBIERI: Astronomical geodetic station at Monte Vesco in July 1930. S. FRANCHETTI: The phenomenon of fusion in relation to a new equation of state and to the lattice structure of solids (1). G. ZANOTELLI: The paramagnetic rotation in a variable magnetic field. The behaviour of the paramagnetic part of the Faraday effect in a variable field has been studied by the method of Beams and Allison (1927). G. R. LEVI and M. TABET: Fibrous structure in ionic lattices (2). The temperature conditions in which AgCl and AgBr give fibrous structures orientated according to (100) and (111) respectively are established, and an explanation is suggested for the variation of behaviour with the temperature. The breaking stress for the (111) orientation is much greater than that for the (100) orientation. V. PUNTONI and N. FAVIA: Loss of virulence of the tubercle bacillus resulting from association with *Bacillus tubercolophilus*. Virulent tubercular strains lose their pathogenic activity when kept in contact with *B. tubercolophilus* on a glycerine-potato medium for 1–2 years. This loss is stable and permanent, as it persists after repeated passages of the organism through sensitive animals. V. CARMINATI: Cariometric determinations on the liver of a tumour-bearing rat on a thymus diet (3). O. VERONA: Spontaneous cultures of the cellulositic aerobe, *Cytophaga Winogradskii*, n. sp. This organism appeared on unsterilised filter-paper cultures. N. SOSTER: Presence of a body of oleaginous appearance in the epidermal cells of the leaves of *Haworthia cymbiformis*. This substance, observed earlier by Guillermond in leaves of *Iris germanica*, seems to contain a phenolic derivative, and possibly flavone compounds. D. MENARINI: Differentiation of the woody elements in leguminous plants. G. AMANTEA and V. FAMIANI: Further observations on persistent beri-beri phenomena due to deprivation of the antineuritic B_1 factor.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, October 20

BRITISH PSYCHOLOGICAL SOCIETY, at 3—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1). Symposium on: "Speech Training".

Sunday, October 21

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Capt. Guy Dolman: "Lemurs, Monkeys, and Apes".*

Tuesday, October 23

UNIVERSITY OF LEEDS, at 5.15.—Lord Rutherford: "The Synthesis of Elements".*

Thursday, October 25

CHADWICK PUBLIC LECTURE, at 5.30—(at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1). Prof. D. B. Blacklock: "Sanitation in Rural Areas in the Tropics and Sub-Tropics, with special reference to Housing".*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. W. M. Thornton: Inaugural Address.

UNIVERSITY COLLEGE, LONDON, at 6.—Dr. Pryns Hopkins: "Current Events regarded Psychologically" (succeeding lecture on November 1).*

Friday, October 26

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical discussion on "Planetary Atmospheres" to be opened by the Rev. T. E. R. Phillips, and continued by Sir Gilbert Walker, B. M. Peek, Dr. Harold Jeffreys and Mr. F. J. Hargreaves.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Frederick Keeble: "The Green Plant as Agricultural Engineer" (Thomas Hawksley Lecture).

INSTITUTION OF CHEMICAL ENGINEERS, at 6.30—(at the Institution of Civil Engineers).—Prof. C. H. Desch: "The Influence of Texture on the Chemical Resistance of Materials".*

SOCIETY OF CHEMICAL INDUSTRY (NEWCASTLE SECTION), at 6.30—(at Armstrong College, Newcastle-upon-Tyne). Prof. A. J. Allmand: "Some Aspects of Photochemical Change".

Official Publications Received

GREAT BRITAIN AND IRELAND

Economic Advisory Council: Committee on Locust Control. Sixth Report: Review of the present Locust Outbreak in Africa and Western Asia and of the Investigations carried out since 1929, and a Note on the General Programme of Further Investigations. (Cmd. 4692.) Pp. 55. (London: H.M. Stationery Office.) 1*s.* net.

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research for the Year 1933. Pp. x+139+11 plates. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

The National Advisory Councils for Juvenile Employment (England and Wales, and Scotland). Joint Report on the Organisation and Development of the Vocational Guidance Service in Great Britain. Pp. 34. (London: H.M. Stationery Office.) 6*d.* net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1585 (T. 3447): Fluid Flow in Rough Pipes. By A. Fage. Pp. 11+10 plates. 1*s.* net. No. 1588 (T. 3483): An Experimental Study of the Stalling of Wings, Aeronautics Laboratory, Cambridge. Pp. 21+12 plates. 1*s.* 3*d.* net. No. 1593 (S. 180): Effect of Wind on the Take-off of Seaplanes. By E. T. Jones. Pp. 14+9 plates. 1*s.* net. (London: H.M. Stationery Office.)

Annals of the Cape Observatory. Vol. 13, Part 4: Observations of Major Planets made with the Heliometer at the Royal Observatory, Cape of Good Hope, during the Years 1922 to 1931 under the direction of Dr. H. Spencer Jones. Pp. iv+115. (London: H.M. Stationery Office.) 8*s.* net.

British Museum and British Museum (Natural History). Annual Report of the General Progress of the Museums for the Year 1933: with a Return of the number of Persons admitted to the Museums, and a Statement of the Principal Objects added to the Collection. Pp. 20. (London: H.M. Stationery Office.) 4*d.* net.

OTHER COUNTRIES

Bulletin of the American Museum of Natural History. Vol. 66, Art. 4: The American Museum Congo Expedition Manatee and other Recent Manatees. By Robert T. Hatt. Pp. 533–566+plate 27. Vol. 66, Art. 5: New and Rare Cuban and Haitian Terrestrial Isopoda. By Lee Boone. Pp. 567–598. Vol. 66, Art. 6: Studies on the Organs of Reproduction in the Nudibranchiate Mollusks. By Leslie A. Chambers. Pp. 599–641+plates 28–31. Vol. 66, Art. 7: The Pangolins and Aard-Varks collected by the American Museum Congo Expedition. By Robert T. Hatt. Pp. 643–672+plates 32–39. (New York City.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 12, No. 10: Clearing and Dyeing Fish for Bone Study. By Gloria Hollister. Pp. 89–101. (New York City.)

Technical Books of 1933: a Selection. Compiled by Donald Hendry. Twenty-sixth Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Chinese Materia Medica. By Bernard E. Read. 7: Dragon and Snake Drugs. (Published by the Peking Natural History Bulletin.) Pp. 66+6 plates. (Peiping: The French Bookstore.) 1.50 dollars.

Proceedings of the American Academy of Arts and Sciences. Vol. 69, No. 7: The Volumes of Unit Mass of Liquid Water and their Correlation as a Function of Pressure and Temperature. Part 3: Steam Research Program. By Leighton B. Smith and Frederick G. Keyes. Pp. 285–314. Vol. 69, No. 8: Contribution from the Department of Biology and Public Health, Massachusetts Institute of Technology, No. 29: The Microbiology of the Upper Air, I. By Bernard E. Proctor. Pp. 315–340. (Boston, Mass.)

Publications of the Observatory of the University of Michigan. Vol. 6, No. 4: A Short-Lived Solar Disturbance. By R. M. Petrie and Robert R. McMath. Pp. 43–44+1 plate. Vol. 6, No. 5: The Variable Radial Velocity of the Star, B.D.+56° 2617 (A). By W. Carl Rufus. Pp. 45–57. (Ann Arbor, Mich.)

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 10, No. 4: Beiträge zur Geometrie der Kreise und Kugeln, 9: Einige Anwendungen der Kreis- und Kugelgeometrie. Von Sôji Matsumura. Pp. 81–174. (Tôkyô: Maruzen Co., Ltd.)

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 1: List of Publications on Indian Entomology, 1930. Compiled by the Imperial Entomologist, Pusa. Pp. ii+45. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.*

Field Museum of Natural History: Department of Botany. North American Trees: Guide to Charles F. Millspaugh Hall. By Prof. Samuel J. Record. Pp. 119. (Chicago.) 50 cents.

U.S. Department of Agriculture. Farmers' Bulletin No. 1729: Machinery for Dusting Cotton. By R. C. Gaines and D. A. Isler. Pp. ii+14. 5 cents. Circular No. 326: Protecting Plants in the Home Yard from Injury by the Japanese Beetle. By W. E. Fleming, F. W. Metzger and M. R. Osburn. Pp. 14. 5 cents. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington. Catalogue of Publications. Pp. xliv+131. (Washington, D.C.: Carnegie Institution.)

Rubber Research Institute of Malaya. Bulletin No. 5: Variations in the Composition of Latex from Clone and Seedling Rubber. By Dr. J. L. Wiltshire. Pp. v+61. 1 dollar. Planting Manual No. 6: The Uses and Control of Natural Undergrowth on Rubber Estates. By W. B. Haines. Pp. iii+23+20 plates. (Kuala Lumpur.) 1 dollar.

Federated Malay States. Report on Forest Administration for the Year 1933. Pp. 89. (Kuala Lumpur: Director of Forestry.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1932, under the direction of Dr. S. K. Banerji and Dr. B. N. Banerji. Pp. xiv+135+5 plates. (Delhi: Manager of Publications.) 13.14 rupees; 22*s.* 6*d.*

The Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30, and previous *Dana*-Expeditions under the Leadership of the late Prof. Johannes Schmidt. *Dana*-Report No. 1: Introduction to the Reports from the Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30. Pp. 130+8 plates. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press.) 16*s.*

Egyptian Government: Ministry of Public Works. Annual Report for 1924–1925. Part 1. Pp. xi+153. 20 P.T. Part 2. Pp. xi+236. 20 P.T. Annual Report for the Year 1925–1926. Part 1. Pp. xiii+178. 20 P.T. Part 2. Pp. xi+230. 20 P.T. (Cairo: Government Press.)

Union of South Africa: Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Investigational Report No. 3: Occurrence of Sulphides in certain Areas of the Sea Bottom on the South African Coast. By W. J. Copenhagen. Pp. 18+2 plates. (Pretoria: Government Printer.)

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1933. (No. 59.) Pp. 90+3 plates. (Adelaide: Government Printer.)

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse Nr. 25: Norges Svalbard- og Ishavs-undersøkelsers Ekspedisjoner til Nordøst-Grønland i årene 1931–1933—Isfjord fyr og radiostasjan, Svalbard. Av Anders K. Orvin. Pp. 31. Skrifter om Svalbard og Ishavet. No. 14: Tidal Observations in the Arctic. By Rolf Kjær and J. E. Fjeldstad. Pp. 29. 6.00 kr. Nr. 62: Vascular Plants from Northern Svalbard, with Remarks on the Vegetation in North-East Land. By P. F. Scholander. Pp. 155. 15.00 kr. Nr. 63: A Contribution to the Archæology of North-East Greenland. By Søren Richter. Pp. 149. 25.00 kr. (Oslo.)

Cattle in the Tropics. By Prof. R. Cecil Wood. Pp. iv+42+4 plates. (Trinidad: Government Printing Office.) 2*s.*

CATALOGUES

The Goliath Tube. Pp. 8. (London: Cuthbert Andrews.)

Collecting Apparatus for Botany, Entomology, Pond Life, Geology, etc. (Catalogue C, eighth edition.) Pp. 48. (Manchester: Flatters and Garnett, Ltd.)

Research Chemicals Price List. Pp. 4. (London: L. Light and Co.)