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Human Problems of Progressive Industry

IN discussing the impact of science upon society in his presidential address at Blackpool to the British Association, Sir Josiah Stamp referred to the necessity of more science to cure the evils which resulted from the impact of science. Ordered knowledge and principles are wanted at every point, and particularly the type of work carried out by the National Institute of Industrial Psychology. Some of its inquiries attempt to improve existing conditions of work. Other investigations endeavour to determine the conditions which allow greater output and efficiency, but much of the work of the Institute is directly designed to combat the evils arising from the new conditions created by modern demands—speed, accuracy and intensity.

While the work of the National Institute of Industrial Psychology thus invokes the aid of many branches of science and is designed to assist in the adjustment of society to the changes caused by technical development, its support is left to personal advocacy. The financial resources of the Institute are only a fraction of the expenditure on research in a single industry, such as rayon, although the contribution of its work to human welfare is immeasurably greater. This absence of assured support to which Sir Josiah Stamp referred so pointedly greatly handicaps the Institute in the prosecution of many of its fundamental investigations. Even if particular industrial firms make use of the Institute's investigators to an increasing extent, industry and society as a whole cannot in this way reap anything like the potential assistance which the Institute could give in smoothing over the transition and readjustment of society under the impact of science.

The endowment of the National Institute of Industrial Psychology, to enable it to carry out its investigations on a scale commensurate with its potentialities in the field of social and industrial welfare, should prove a profitable investment from the point of view of industrial as well as social efficiency, and might well form one of the first objectives of scientific workers in the field of social science. Moreover, the potentialities of vocational guidance, in which field the Institute has carried out such admirable work, as a factor in avoiding misfits and checking juvenile unemployment, can scarcely be said as yet to have received anything like adequate appreciation, although the impending shortage of juvenile labour makes the work the more important.

The importance of research of this type was stressed by Sir Kenneth Lee in an address to the Bradford Textile Society on November 17. Sir Kenneth urged that research on the human side is just as important in modern industry as research on the chemical and physical properties of the products being manufactured. Discontent and unrest are often due largely to working conditions, and a central co-operative research association should give its attention to the investigation of problems of this type. Causes of workers leaving, abnormal labour turnover, absenteeism, or high sickness incidence demand as rigorous attention and investigation as a fall in the efficiency of a manufacturing process, and fatigue and incentives are fields which should amply repay any research carried out in them.

Like so many other speakers on this question, Sir Kenneth Lee once more emphasized the significance of management in industrial efficiency.

The very rapidity of change and development in industry to-day tends to make plant and machinery of secondary importance. The greatest asset of a business is increasingly the ability of its staff. Significantly enough, this is essentially the first point emphasized in the report of an inquiry into vocational education after general education up to sixteen years of age carried out by a Committee on Commercial and Industrial Education of the British Association.

This Committee in its report emphasizes the growing tendency of firms to recruit university graduates, not for their technical knowledge but because of their disciplined mind and trained intelligence, for some of the higher administrative posts in business. Thus increasing use of the university graduate in technical capacities is likely to be paralleled in his employment in administrative capacities. Similarly the Committee notes the tendency of the larger firms to select an increasing proportion of boys from secondary and public schools at the age of eighteen years.

These factors alone indicate the way in which the standard of recruitment is being raised in industry. They also intensify the problem of vocational guidance, the use of which to prevent misfits either at the start or in selection for promotion to higher managerial posts becomes increasingly desirable and important. One of the arguments in favour of part-time education is, in fact, that entrance to employment at sixteen years of age results in fewer ultimate misfits than entry at eighteen years, when valuable time may have been spent in preparing for a particular occupation.

That more strenuous efforts should be made to eliminate or rather prevent misfits occurring in all ranks of industry is undoubtedly true, if we are to attain the standard of efficiency visualized both by Sir Josiah Stamp and Sir Kenneth Lee, and part-time education may be an important factor in that effort. The report makes it clear that the part-time education required to-day is not of the evening-class type upon which such reliance was formerly put and upon which severe comments have been made in recent years. It is part-time day education in which industry has arranged for the release of its young employees during working hours. Moreover, it is suggested that the sandwich type of vocational education, under which alternate periods of, for example, six months, are spent in the works and at school, should be adopted more frequently as a means of training suitable candidates for posts of higher responsibility.

This suggestion is, of course, essentially similar to the seconding of selected individuals of proved ability and sufficient experience for special training in management and administration with the view of recruiting them for the higher managerial posts as vacancies and opportunities occur. The recently announced staff college to be established near Derby by the London, Midland and Scottish Railway is essentially a development on these lines.

Such developments tend to diminish the importance of, and demand for, full-time vocational training for recruits for industry up to sixteen years of age, although at the same time the need for vocational guidance is enhanced and also the efficiency of vocational training after that age. The later age of entry to industry, whether from school or university, will increasingly be accompanied by a short intensive course of training after entering industry, designed to assist in the transition from school to work and in the application of the disciplined mind and scientific principles acquired in a liberal education to the particular problems characteristic of the branch of industry involved.

One important effect of the rising standard of management should undoubtedly be increasingly felt. The management of to-morrow will, as Sir Kenneth Lee suggests, attach increasing importance to the human factor. It will accordingly make much fuller use of methods of vocational selection and guidance, and may be expected to support much more generously and widely investigations on the long-range and practical problems involved, whether the research is initiated within a particular firm or by a research association or by such an organization as the National Institute of Industrial Psychology. Management of this type will not tolerate the position so strongly criticized by Sir Josiah Stamp, but it should not be necessary to wait for the rising standard of administration in industry to secure any important modification of the present anomalous position.

At the present time, apart from the National Institute of Industrial Psychology and the work of the Industrial Health Research Board, little attack is being made on the broader and more general problems akin to the long-range and fundamental work in the physical sciences which is at present so largely the domain of the universities. Even if the work done in the field of industrial relations in different universities were extended to cover the study of social change and

the industrial surveys and studies of juvenile unemployment, of wage payments and labour conditions and of the location of British industry, which in recent years have been or are being carried out by the Economics Research Section of the Faculty of Commerce and Administration at the University of Manchester, for example, found parallels in the majority of our universities, still the consulting work of the National Institute of Industrial Psychology would be required on a much wider scale.

There are in fact two main needs. The first is a growing appreciation of the importance of the social and human factors, which would naturally be accompanied by a greater realization of the value of the Institute's work and a greater willingness to support it freely. In meeting this need the more effective training for management will assist, but scientific workers can equally play their part by following Sir Lenneth Kee's example. The second need is that of planning the resources available both within industry and without, so as to secure that a concerted attack is made on the problems confronting us and that the knowledge acquired is made available as widely as possible for immediate application. This again can only be completely met as industrial leadership becomes conscious of its opportunities and responsibilities, but even to-day much more could be done to create or arouse interest, above all if scientific workers set themselves seriously to formulate a plan and to outline the agencies and means and resources for its execution. The demonstration of the way in which bad social or industrial systems or conditions frustrate science and lower industrial or social efficiency, or the factors which tend to diminish such efficiency is, as Mr. J. G. Crowther has reminded us, one of the major social responsibilities of scientific workers, and one which their position in industry to-day gives them increasing opportunities to discharge.

At the same time, many of the fundamental factors involved must be ascertained by the academic worker. Dr. Julian Huxley has pointed out the necessity for creating research institutes where work of the independent type carried out in a university is possible. A true social service can only evolve when such problems as unemployment are studied over the whole range of society, and the opportunities which already exist in Government service in regard to planning and social and industrial surveys as well as in industry, both in regard to economics, labour and welfare questions and the study of public relations, are supplemented in this way.

Apart altogether from the need for more experiments of the regional type exemplified by that which has been put into force under the Tennessee Valley Authority Law of May 18, 1933, social service has yet to formulate its methods. Progress is delayed by the absence of an adequate technique as much as by anything else. Particularly is this true when multiple causation and multiple effect complicate almost every social problem, and the investigation has to take account of several contributory factors or causes and as many or more effects. The practical impossibility of achieving complete isolation demands an appropriate technique in handling such ideas in scientific practice.

Nor are these the only difficulties to which Dr. Huxley has directed attention. The loose discussion of abstract terms, such as justice and truth, is a stumbling block, and such terms require rigid exclusion from sociological discussions. Here scientific workers could do much more to organize the concerted exposure of those who by jargon and misleading or inaccurate phraseology persistently oppose progress. Again, the social investigator cannot ignore prejudices. He has to learn to discount and control bias and to study the whole question of the place and use of propaganda and enthusiasm.

The fundamental reason for the wider interest in applications of science to social questions to day, whether in the industrial world or not, as for the development of a true science of society, is the belief that the accumulation of social knowledge along scientific lines provides a basis for better and more effective social action. We can scarcely contemplate any branch of applied science to-day, or any of the new powers, such as broadcasting, with which it has endowed mankind, without realizing the tremendous possibilities for good or for evil which turn on the use or abuse of that knowledge and those powers. If the increasing direction of industry by science initiates much more research into the human problems of industry, that is likely to be but one step more towards the conversion of science from a series of isolated social nerve centres into that which Dr. Huxley firmly maintains it is intended to be—a real brain for society. Not the least consequence of such a transformation would be the development of social mechanisms designed to prevent the appalling blots in our present social system represented by the "Special Areas" of Great Britain.

Agricultural Surveys

A Survey of the Agricultural and Waste Lands of Wales

Edited for the Cahn Hill Improvement Scheme by R. G. Stapledon. Pp. xv + 143 + 9 plates. (London: Faber and Faber, Ltd., 1936.) 15*s*. net.

ALL national and local inquiries into the condition of the agricultural industry have emphasized the lack of comprehensive and specific data which might be of use in the planning of large-scale remedial measures. Wales is indeed fortunate in having two important surveys in progress—one, a rapid botanical survey of its grass lands by Prof. R. G. Stapledon of Aberystwyth, the other a soil survey by Prof. G. W. Robinson of Bangor.

The methods adopted in the grassland survey are new and interesting, and if, as the authors claim, they are sufficiently detailed to classify grassland according to its standard of improvability, they form a rapid and inexpensive way of surveying our whole land utilization problem. Soil surveys, on the other hand, are much slower and more laborious undertakings that cannot keep pace with botanical surveys, such as that described in the publication under review. The soil surveyor must, of necessity, take account of the soil to its full depth, and the soil 'profile' as a whole cannot be viewed from the 'vantage point' from which the trained ecologist can distinguish and map the major plant associations.

Do the main grassland associations, which apparently in Wales take no account of geology, ignore also soil 'series'? What is still more important, will the more useful herbage, improved by manuring and cultivation, continue to take no account of soil 'series'? Usually it shows them up, so that the higher the degree of improvement aimed at, the more essential is it to know all about the soil 'series' and their limitations.

The real test of a surveyor's classification of grassland or of soils is his ability to put his types or series on to a map; only thus is the true significance of the differences between types appreciated. This has been done, and well done, for the pastures of Wales, and the most valuable part of the book is the grassland map of Wales, beautifully produced and neatly tucked into the back of the book.

The ecologist, used to complicated areas, may look askance at the broad generalizations, but he is referred to the specimen area maps and tables from which the generalizations have been made, and reminded that the editor's concern is for seventy-five per cent of the total agricultural area of Wales and the still undetermined area of similar grazings in the rest of Britain waiting for a similar survey.

The purpose of the survey is to gain information for a policy of better utilization of land and it is, perhaps, unfortunate that the editor cannot yet combine the results of his very rapid, but none the less convincing, botanical survey with a soil survey of the same region based on the carefully devised technique now being employed at those British agricultural research centres with soil survey organizations. A brief account of the 'series' method of soil mapping is given in Chapter iii of the book, which includes also descriptions of some named 'series' and some general conclusions on the soils of Wales. But for the purpose of this survey, only certain coastal areas with possibilities of development of more intensive horticultural methods have been surveyed and mapped, and the soil types (not series) described. Here again the maps are excellent.

The main theme is, however, pasture types, and William Davies is responsible for an excellent chapter describing his methods and his results.

Cultivated pastures are divided into four types; the best of these, the rye-grass pastures, cover only 16,000 acres in all, or 0·4 per cent of the total agricultural area. Further, the standard arbitrarily fixed, a perennial rye-grass content of not less than 15 per cent, is not high. Typical pastures in Wales give up to 40 per cent rye-grass, whereas a ley in its third year gave 52 per cent. Below them in order of merit come *Agrostis*-rye-grass, ordinary *Agrostis* (38 per cent of total agricultural area) and *Agrostis*-rush pastures.

The presence of rushes over such large areas of (nominally) cultivated land in Wales is frequently referred to, and touches on an important point in grassland improvement. Rushes are generally associated with impeded drainage, and Wales has no monopoly of them. Although, as at Cockle Park, basic slag will often open up the surface soil and allow water to percolate more freely, the real trouble is usually inadequate drainage, and that not always the absence of drains but complete stoppage of an existing drainage system.

The survey emphasizes again the marked superiority of new temporary over old permanent pastures. The authors consider that usually a ley will need re-ploughing after about ten years, but they state that "ordinary leys sown out with commercial seed will maintain their botanical composition for about two years", the sown species then being gradually replaced. How rapidly deterioration

of new leys proceeds depends partly on how well the seeds mixture has been designed to suit the system and standard of farming for which it is intended, and how well that standard is maintained.

The *unenclosed grazings* are divided into seven types which include the 'maritime association' in addition to fescue-*Agrostis*, mountain fescue, *Mollinia-Nardus*, cotton-grass moor, heather moor and heather 'fell'; of these, *Mollinia-Nardus* is most widespread (17 per cent of total agricultural land), and is next in area after the cultivated *Agrostis* land.

An important feature of some of this land is the occurrence of mature or immature peat, the latter often referred to as 'mat'. This mat is one of the greatest drawbacks to land improvement. It proved probably the worst impediment to rapid cultivation of grassland ploughed out during the Great War for corn production. These 'mats' are common not only on hill pastures, but also on lowland pastures with acid soils. They are often worst where this acidity is emphasized by the acid-polluted atmosphere of industrial districts. Liming is a cure, but an expensive one in hill areas. On Cahn Hill Professor Stapledon has done valuable work in dealing with these 'mats' mechanically. To get them out of the way so that seed and manures can be brought into immediate contact with the soil is essential to complete success. Comparatively light implements or the plough will deal with very immature 'mats', but the thick tough 'mats' found in the worst cases need some kind of heavy rotary tiller, followed by complete destruction of the 'mat' by burning.

The improvement of these unenclosed types of land has been tried with success at Cahn Hill, where there is a series of experiments that will be of enormous interest for some years. They are not merely trials of methods but also severe tests of the value of those pedigree strains of grasses painstakingly produced by the Aberystwyth workers over a large number of years.

These grassy moors with their mixed associations occupy a very low place in the scale of productivity. Here again Wales has no monopoly; in the Cheviots they are thinly populated by sheep which in spite of low stocking often suffer severe losses from disease. How far this disease is due to parasites or under-nutrition or both is a point under investigation on the Cheviots at the present time. In spite of careful herding, the area closely grazed by the sheep is small. Where it is grazed and trodden there is usually an association of finer grasses occupying perhaps scarcely 10 per cent of the whole grazings, and maybe giving conditions conducive to that parasitic infestation so frequent in these hill sheep. Under-nutrition, especially so far as minerals are concerned, is undoubtedly a factor of importance on these hills, and herbage with extraordinarily low calcium and phosphoric acid has been collected in the Cheviots. Prof. Stapledon's call for more lime, more phosphate, is more than justified, but what is the economical way of supplying it, direct or through the grass? The second alternative is very costly on areas so inaccessible, and, so far as some results go, it is questionable whether basic slag will serve the dual purpose of increasing adequately both calcium and phosphate in the herbage.

But of all these low-grade grazings in their unimproved condition, perhaps a well-tended heather moor is the most valuable possession. Only proper attention, mainly periodical burning, will keep down the inevitable encroachment of *Nardus* or—as William Davies prefers to regard heather as the trespasser—will encourage the heather to take complete possession of fresh areas. Speaking generally, good heather moors are worth attention from the sheep as well as the game point of view. Heather has an extraordinary ability to take up lime even from soils of low base status. The younger shoots of heather may have a calcium content as high as good pasture grass, although the phosphate content is low. Other plants like cotton-grass (*Eriphorum vaginatum*) often associated with the heather are rich in phosphate and poor in calcium. Moreover, the heather has little seasonal variation in composition.

The most striking figure in the tables is the proportion of *Agrostis* pasture (38 per cent) and that on cultivated land. It suggests immediately land once reclaimed and now partially derelict. It represents probably the most promising of the unimproved land—promising, that is, from the economic point of view.

By means of specimen maps of zones of the various grassland types, tables of typical pasture analyses with explanatory notes facing them and the description of procedure in the field, the directions to the ecologist who would deal similarly with some other part of the country are clear; and because of these tables and the maps, not forgetting the main map, the book should prove a most useful book of reference.

If Prof. Stapledon's method of approaching this national problem by simply grading up pastures of one class to the next better class were appreciated and understood, the problem of the better utilization of our land would appear much less fearsome. Soil fertility is most securely locked up in good, well-tended grassland, and it can be drawn upon very quickly. More live-stock, especially cattle, are needed to increase and maintain this fertility and they are also needed to apply those extra fresh foods, meat and milk, demanded by research workers in human nutrition.

J. A. H.

Bio-Climatology

The Patient and the Weather

By Dr. William F. Petersen, with the assistance of Margaret E. Milliken. Vol. 1, Part 1: The Footprint of Asclepius. Pp. xx+127. 3.75 dollars. Vol. 1. Part 2: Autonomic Integration. Pp. xxxi+781. 9 dollars. Vol. 2. Autonomic Dysintegration. Pp. xx+530. 6.50 dollars. Vol. 3. Mental and Nervous Diseases. Pp. xvi+375. 5 dollars. (Ann Arbor, Mich.: Edward Brothers, Inc., 1934–1936.)

IN these volumes Dr. W. F. Petersen, of the Department of Pathology and Bacteriology of the University of Illinois, discusses and illustrates the age-old doctrine of the influence of the weather upon health.

The picturesque thesis which runs through this work, that man is a "cosmic resonator", is only a modern expression of man's relation to Nature as taught by Hippocrates. It belongs to all countries and times, in one shape or another, and sometimes in strange forms, as in astrology. It is usually more conspicuous in popular than in academic medicine. In our own time it has had many powerful exponents—meteorologists and physicians—and has already acquired a sound basis through the work of Loewy, Dorno, de Rudder, Leonard Hill, Häberlin, Kestner and others in the new science of bio-climatology. There is much to say for the author's criticism that the schools of medicine, with their thought centred on infection, have failed to recognize the cardinal importance of atmospheric environment and inherited constitution. Haldane pointed out that many germs of disease, like the tubercle bacillus, are harmless to the average person, and attack others for unknown reasons. Why? It is time that medical thought turned from the micro-organism to the patient. Man has been described as a nucleus of mentality in a material environment. Certainly the fact cannot be ignored that a long range of physical impressions is continually falling on a corresponding keyboard of receptor organs.

A president of the Royal College of Physicians once remarked to the reviewer that he was unable to believe in the alleged effects of a 'change of air' because chemical analysis had shown that the composition of the atmosphere was everywhere the same. There is, however, abundant evidence to the contrary in the behaviour of plants. Many an 'air taster', highly sensitized no doubt, declares that he feels the influence of the air in one direction or another (stimulant or relaxing) even when halted for a few minutes on a railway platform. There is also the common experience of the cessation of catarrh, and increased appetite and energy, on arrival at a coast that 'agrees with you'. Such reactions occur in normal persons. How much greater sensitiveness may be expected in illness? Häberlin and his school have demonstrated and measured a series of reactions occurring in delicate children from atmospheric causes. Dr. Petersen holds that in different constitutional states the normal biological reactions are accentuated or modified. The operating mechanism is the autonomic nervous system, which, especially in sensitive subjects, is liable to lose its normal balance and pass into imbalance or dysfunction, and eventually permanent disease. The normal reactions occur in two successive phases, indicated as *ARS* and *COD*. In the former *A* stands for *a*nabolic and (in general) alkalinity, *R* for preponderating *r*eduction and *S* for *s*pasm—the systolic blood pressure rising, with a supposed preponderance of adrenal influence. The tissues are increasingly anoxæmic, with accumulation of carbon dioxide. The *ARS* phase gradually or abruptly gives place to its opposite *COD*—in which *C* stands for *c*atabolism and relative acidosis, *O* for *o*xidation and *D* for *d*ilatation, with falling diastolic blood pressure and supposed thyroid preponderance, the reaction changing to alkaline and carbon dioxide diminishing. These phases may be general throughout the body, more commonly perhaps regional. In a state of health (autonomic balance) the rhythm is normal, but in autonomic dysfunction the peaks and troughs are exaggerated. It is the aim of the present work to relate these abnormal reactions to external physical causes over a wide field of disease.

The degree of temperature and its variability are naturally the cardinal factors in atmospheric environment. Cold regions make large demands on metabolism, increase body heat and a tendency to acidosis. Hot regions evoke minimum metabolism and a tendency to alkalosis. But, unexpectedly perhaps, the tropical climate predisposes to chill, for when occasionally the temperature falls, chill may result because the power of accommodation, so little called upon, is found to be wanting. American experts in heating have shown that temperature by itself is no measure of physiological reaction. What has been called 'effective temperature' in defining 'comfort zones' is an "arbitrary index of the degree of warmth or cold felt in response to temperature, humidity

and air movement". Composite impressions of this kind are characteristic of climate, and are especially worthy of study, especially on the path of anticyclones, to a description of which much space is devoted. The author agrees with Huntington in his "Civilisation and Climate" that frequent storms, with decided changes from day to day, are the most favourable to health and mental activity, and that the effective temperature is largely conditioned by latitude, winds and expanses of water. The statement that climate and weather are the most important of environmental factors will now be largely accepted: also that, being too familiar and unimpressive, they are unfortunately generally overlooked by the physician. To speak, however, of atmospheric influences as always stimulating is at least misleading. In England especially, it is now held that sedative effects are equally obvious and important, especially in climatic treatment; and it is certain that these external influences, whether accelerating or retarding, ought not to be disregarded, for they are powerful enough to affect not only the organic but also the psychic functions, and even the social and economic conditions of those who are habitually exposed to them.

The greater part of these volumes is occupied with minute investigation of the reactions of many groups of individuals, exposed to the atmospheric changes exhibited in meteorographs. As bearing on these data, the well-known fact is quoted that sub-minimal stimuli, producing no obvious effect, increase the lability of the cell and when repeated may produce important summation effects. The importance of more precise study of the reactions induced by atmospheric environment is properly emphasized. Many disorders connected with autonomic instability are increasing in the United States. A rational therapeutic principle must be not merely palliative but also must take account of the profound influence of physical influences and dietetics, and their great possibilities in the control of disease.

The author modestly states that these three volumes, extending to 1,800 pages, are only a "puny entering wedge". The reviewer may be forgiven a sigh of relief that every treatise is not framed on such generous lines.

Study of Fungi

A Text-Book of Mycology

By Prof. E. A. Bessey. Pp. xv+495. (Philadelphia: P. Blakiston's Son and Co., Inc., 1935.) 4 dollars.

A TEXT-BOOK of mycology that will satisfy all demands is perhaps impossible of attainment by one writer and in a reasonably small volume, so wide is the field now covered by the subject. Prof. Bessey has attempted to meet the need for guidance through the vast amount of work on structure, life-histories and classification of the fungi, and in many respects the result is admirable.

The book opens in the usual way with a general account of the fungi, and this is followed by a brief history of work on the classification of the group. Chapter ii deals with the non-filamentous fungi, and also the Mycetozoa and allied groups, these being included not because the author agrees that they are fungi but because they are still so regarded by many workers, and usually come to the mycologist for identification. Chapters iii—v deal with the Phycomycetes, and Chapters vi—xiii with the higher fungi, three being devoted to Ascomycetes, one to rusts and smuts (as a special class Teliosporeæ), and three to the Basidiomycetes proper. Chapter xiv is concerned with the Fungi Imperfecti. While the space devoted to the latter is a little more than that given in most botanical text-books, the treatment is not as satisfying as is that of other groups. In this case Prof. Bessey has relied for his information on an unpublished thesis by a student of Yale University, H. B. Bender. It is unlikely, on the face of it, that such a work can be anything more than a very uncritical compilation, since even an experienced mycologist would be daunted by the task of revising the whole of this huge assemblage of forms, many of them little known and imperfectly described.

The space given to Phycomycetes may seem disproportionate to the size of the group, but is accounted for by the great interest of these fungi from the points of view of cytology, biology and phylogeny. The author throughout has endeavoured to indicate possible phylogenetic relationships. One may not always agree with his views, but the method of treatment is essential if the student is to attain a grasp of the ultimate ideals of morphology and taxonomy. It is fair to point out that the author indicates alternative views, and in general stimulates the student to think for himself.

In a book of this type, errors and omissions are inevitable, and no doubt any specialist might find small points at which to cavil. To the present writer it occurs that there is no mention of *Sporobolomyces*, the yeast which has called forth so much controversy as to its systematic position. Again, on p. 338 the author assumes that all segregates from the genus *Fomes*, as treated in Saccardo's "Sylloge", produce successive layers of pores, which is certainly not the case either in *Amauroderma* or in most species of *Ganoderma*. Typographical errors are very few ; *Dædalia* and *Cantherellus* (both on p. 351) may be pointed out as unfortunate. The figures are the least satisfactory part of the work in that they are in many cases very poor and coarse reproductions. A comparison of Figs. 17 (p. 46) or 22 (p. 62) with the originals from which they are taken is sufficient to indicate the character of the work in this respect. It is to be hoped that these faults may be remedied in a future edition.

The book is to be recommended for the very full references to literature. At the end of each chapter is a list of relevant books and papers, and Chapter xv is given up to a "guide to the literature for the identification of fungi", the titles being classified into those covering the whole field and those dealing with special groups. It is not and does not claim to be complete, but is undoubtedly a valuable guide to those who may have little idea (and what beginner has ?) where to look for information as to the fungi in which they are interested. E. M. W.

Refining of Petroleum

Petroleum Refinery Engineering

By Prof. W. L. Nelson. (Chemical Engineering Series.) Pp. viii + 647. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 36*s*.

IT has been frequently urged that the refining of petroleum constitutes one of the most important branches of chemical engineering, and that Great Britain will be at a serious disadvantage so long as this industry is largely non-existent here. Ample evidence for such a claim is afforded by the contents of Prof. Nelson's compilation. He points out that the industry utilizes most of the unit operations of chemical engineering and that the great progress which oil refining is now making technically is due to the adoption of chemical engineering principles.

Petroleum refining in its many branches is a typical chemical process industry conceived on the largest operating scale ; it is giving employment to more chemical engineering graduates than any other branch of the chemical industry and it affords likewise the largest single market for chemicals.

The first real refinery was built at Titusville, Pennsylvania, at a cost of £3,000 in 1860, and before many years several hundreds of small refineries were in operation, using the batch system. They were replaced by continuous plants, in which the principle was recognized of allowing the oil to flow continuously in a thin stream over the heating surface. The large modern distillation plants are built up of interconnected units with common heat-exchange systems. The next discovery was cracking both in the liquid and vapour phase, which materially adds to the amount of motor spirit produced from the crude oil. The quantity was still further increased by stripping natural gas and again by the application of the hydrogenation process. The development of distillation in vacuum and of solvent extraction has enabled superior lubricating oils to be produced.

It is perhaps of interest to follow the changes in the public demand for oil products. From 1860 until 1885, the demand was for kerosene or burning oil, and too much low flash-point spirit was looked upon as a disadvantage. In 1885–90 the mineral lubricating oils gradually displaced vegetable oils for all purposes. The advent of the motor-car made petrol the most useful product of the refinery, and after 1914 there was an urge to recover more of it from the crude. From 1920 onwards, fuel oil as a means of producing heat and power came into demand. During the last ten years the methods of producing lubricating oils have been radically changed, and quite recently much more stringent specifications have been imposed for these, adding greatly to their utility. The demand for anti-knock petrol led to further plant developments which, in their wider application, have resulted in improved road oil and asphalt products. The capacity of the oil refineries in the United States is at least four million barrels per day.

Prof. Nelson's book sets out what the refinery engineer may be expected to know. Naturally

the fundamental data include a knowledge of the raw material and of the refinery products, including the evaluation of oil stocks. The principles of design demand attention to such matters as hydraulics, combustion, heat balances and transfer, vaporization and condensation, counter-current operations, corrosion and the theory of cracking.

Under the heading of plant processing comes a knowledge of the various sections of plant, of cracking processes, natural gasoline, chemical and earth treatment, dewaxing and much besides.

This has all to be handled in six hundred pages, a task involving much compression and an ability to confine the matter to essentials which only practical knowledge can give. The text is supplemented by numerous tables and diagrams.

The author writes from Tulsa, to-day an important city in the centre of the Oklahoma oil-field, though it was non-existent a few years back: he has had the help and advice of many of the well-known men in oil technology.

E. F. A.

Physico-chemical Tables

Landolt - Börnstein Physikalisch - chemische Tabellen

Fünfte, umgearbeitete und vermehrte Auflage. Ergänzungsband 3. Herausgegeben von Prof. Dr. W. A. Roth und Prof. Dr. K. Scheel. Teil 3, Hälfte 1. Pp. xvi+1815–2352. Teil 3, Hälfte 2. Pp. 2353–3039. (Berlin: Julius Springer, 1936.) 188 gold marks.

THIS volume completes the third supplement to the fifth edition of the well-known "Landolt-Börnstein" tables and makes available a mass of physical and chemical data including work published so late as March 1936. The growth of this standard work of reference demonstrates the remarkable expansion of the physical sciences in our time. The fifth edition was first published in 1923; it occupied two volumes and 1,695 pages. The first supplement appeared in 1927 with 919 pages, the second in 1931 consisted of two volumes and 1,707 pages, whilst the third supplement which began to appear in 1935 has grown to three volumes and 3,039 pages. Prof. Roth and Prof. Scheele, to whom we are indebted for this work, must feel the satisfaction of a great task well accomplished; at the same time they must view with some dismay the probable dimensions of the next supplement in 1939–40.

The first two parts of the third supplement have already been reviewed in NATURE; this third part is concerned with data classified under the headings of electricity, magnetism, thermochemistry and thermodynamics. Only a few of the numerous tables can be mentioned. There are many new data on dielectrics, including a number of tables and diagrams on the properties of solid dielectrics. The section on electromotive force and on conductivity covers many pages, and a particularly valuable feature of this part of the volume is a series of tables of activity coefficients. This extends to more than thirty pages and gives values of γ over a range of concentrations for many aqueous and non-aqueous solutions. The growing interest in magnetism is reflected in the tables of new measurements of dia- and para-magnetic susceptibility, whilst the section on thermochemistry includes important new tables dealing with the energy of chemical bonds and the ignition temperatures of gases. The index covers the eight volumes of the complete work and is accompanied by an index of the properties of common substances.

The literature of science continues to grow at an ever-increasing rate, and presents a more difficult and complex problem in each generation to those who construct really comprehensive works of reference. The mere size of these tables, which deal only with numerical data in two related sciences, helps one to apprehend the magnitude of the general problem of the indexing of scientific literature, upon which much has been written both in NATURE and elsewhere. The team of devoted workers who under the direction of Prof. Roth and Prof. Scheele have brought into being this third supplement to "Landolt–Börnstein" have rendered a notable service to science and to industry all over the world.

Works of this kind must of necessity be expensive, but the increasing cost of these tables has been felt even by colleges and institutions, and is a very heavy burden on those who maintain a private library. It is therefore pleasant to find this last volume accompanied by a pamphlet announcing the twenty-five per cent reduction in price to countries outside Germany, with the exception of Switzerland and Palestine, to which German books are now subject.

S. S.

Psycho-Analysis and Social Psychology
By Prof. William McDougall. Pp. ix+207. (London: Methuen and Co., Ltd., 1936.) 7*s*. 6*d*. net.

PROF. MCDOUGALL says in his preface that he has "returned to the always interesting, but generally quite futile, task of criticizing the teachings of Professor Sigmund Freud and his school. . . . I have realized too late that I might have done much more for my chosen science, had I from the first spoken with a less modest voice. It seems to me probable that, had I at the outset put forward my views in a more self-assertive and clamant fashion, I might have been acknowledged as the leader of a powerful and perhaps dominant school of psychology; instead of remaining a well-nigh solitary outsider playing a lone hand".

Such a personal note, in the preface and even more in the three Lectures (delivered in the University of London, May 1935) which form the nucleus of the book, rather impedes the author in a critical handling of his subject. He holds that Freud is right in regarding human nature and behaviour as always and everywhere purposive, conative, hormic, but that in almost everything else Freud is in confusion or in error. On several points, the author makes pertinent criticisms, particularly in respect to the 'death-instinct' about which Freud himself writes with scepticism, though nothing constructive is offered in their place. But the concepts of unconscious mental processes which affect not only neurotics but also normal people; of the persistence of infantile modes of thinking in this unconscious part of the mind; of an *interplay* between loving or tender and aggressive or destructive impulses which only slowly reach stability; the important part played by anxiety and guilt in the development of the personality, particularly in infancy—these and other characteristically Freudian concepts are either profoundly misinterpreted in the author's exposition, or ignored.

An understanding of social psychology is an urgent need at the present time, for never has propaganda been so rapid and intense as in Europe to-day. It is a matter for great regret that the opportunity offered to a pioneer in social psychology by a university and by publication should have been spent in a "futile task" rather than in developing the present state of knowledge by addition to theory or by new observation. JOHN RICKMAN.

Aural Therapy in Relation to Deafness
By Prof. D. F. Fraser-Harris. Pp. 45. (London: The Sterling Medical Publishing Co., n.d.) 7*s*. 6*d*.

THIS little book, which is introduced by forewords from Sir James Purves-Stewart and an anonymous professor of the faculty of medicine in an English university, consists of six chapters. In the first, in which a short account is given of the varieties of deafness, the author points out that deafness is very rarely the result of a direct infection of the central organ of hearing but is nearly always the secondary result of generalized infections, such as measles, scarlet fever, typhoid fever, rheumatism and some forms of catarrh of the nose and throat.

In the second chapter the various causes of deafness are described, such as obstruction in the external ear by a polypus or wax, perforation of the tympanic membrane and otosclerosis. In the third chapter, which is devoted to the diagnosis of deafness, a description is given of the audiograph, an instrument designed for the accurate measurement of sound. The result of its use has been that with certain exceptions the various types of deafness have been found to present characteristic audiographic charts of their own, which are reproduced. The remaining chapters are concerned with treatment, especially by hearing aids and the thermal catheter.

In conclusion, the author acknowledges the indebtedness of otology to the physicists who, from the time of Graham Bell, by their intensive study of the measurement of sound, have rendered possible the delicate acoustical instruments which have so advanced otology.

Biological Time
By Lecomte du Noüy. Pp. x+180. (London: Methuen and Co., Ltd., 1936.) 7*s*. 6*d*. net.

THAT the biological aspects of the conception of time form a real problem cannot be doubted. Even the expression 'biological time' may have a meaning, if judiciously defined. The present book is built around three experimental facts closely connected with the flow of time: (1) the very regular falling off in the rate of healing (the cicatrization index) of wounds according to the age of the organism; (2) the regular fall in the growth-promoting power of serum for explanted cells with the age of the donor; and (3) the dependence of the subjective estimation of time on experimentally alterable factors, especially temperature. The book, however, has many disadvantages. At least one third of it is not at all germane to the principal issue, and in many places we miss citations of the relevant literature, even where it is French, the language in which this book was first published. It is concluded, *inter alia*, that there is a physiological time which does not flow uniformly like physical time, and that time has a discontinuous or atomic nature. The book is unfortunately marred by numerous errors of translation which in some cases may lead to confusion.

Television Optics:
an Introduction. By L. M. Myers. Pp. x+338. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 30*s*. net.

IN view of the many discursive books on the practice of television, this text is opportune, in that it sets out for the first time in book form the relevant physical data on lenses, Kerr cells, and electron focusing, and the relative effectiveness of various methods of scanning. More significant is its scientific accuracy and completeness; no important detail seems to be omitted which has a bearing on the optical performance of the many types of system. With its extensive bibliography and logical layout, Mr. Myers's book should prove to be a very valuable source of reference for students for many years to come.

L. E. C. H.

The Spectroscope and the Atom*

By Prof. Alfred Fowler, C.B.E., F.R.S.

IN his Thomas Hawksley Lecture of 1932, Lord Rutherford recounted the experiments with atomic projectiles which had given so much insight into the structure of atomic nuclei. My principal aim now will be to indicate how the spectroscope has contributed to our knowledge of the systems of electrons surrounding the nuclei of atoms, on which chemical and other properties are dependent.

Spectrum of Hydrogen

The simplest spectrum of all is that of hydrogen, showing the well-known Balmer series of lines in the visible region, in which the wave-numbers, ν, are represented by the formula,

$$\nu = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

where $n = 3, 4$, and so on, and the *Rydberg constant* $R = 109{,}678$ as calculated from the lines themselves.

Other series of hydrogen lines similar in appearance to the Balmer series were afterwards discovered, and it was found that the entire spectrum could be represented by the general formula

$$\nu = R/n_1^2 - R/n_2^2 \text{ when } n_1 < n_2.$$

$n_1 = 1$, $n_2 = 2, 3, \ldots$, gives the Lyman series in the extreme ultra-violet; $n_1 = 2$, $n_2 = 3, 4, \ldots$, the Balmer series; $n_1 = 3$, $n_2 = 4, 5, \ldots$, the Paschen series in the infra-red, and so on. Theoretically, the number of series is infinite. The Rydberg constant R appears with slight modifications in the formulæ for series of lines in the spectra of elements other than hydrogen.

It is of special importance to note that the wave number of each spectrum line appears as the difference of two other numbers. These are the so-called *spectroscopic terms*, each of which, in accordance with Bohr's theory, is proportional to a particular energy state of the atom.

Series in other Spectra

Similar regularities occur in the spectra of elements other than hydrogen. Many of these spectra are built up by a number of superposed separate series, illustrated for lithium and sodium in Fig. 1. Four of the series have received special names—*principal*, *sharp*, *diffuse* and *fundamental*, respectively.

As in the case of hydrogen, each of the above-mentioned series may be represented by the differences between a spectroscopic term representing the limit of the series and a *sequence of terms* given by a running number. In the simple form adopted in the classical work of Rydberg, a term R/n^2 in the formula for hydrogen is replaced by $R/(m+a)^2$, where m stands for a sequence of integers and a is a fraction special to the particular series. It is found that the different series are closely related to each other, so that the limit of one series is a member of one of the other sequences of terms. The sequences, as distinct from the lines, are named S, P, D, F, after the series in which they occur. If the first terms of the S, P, D sequences are assigned the number 3, as would be the case for sodium, the relations between the series may be shown as follows:

Principal series .	$3S - nP$	$n = 3, 4, 5, \ldots$
Sharp series . .	$3P - nS$	$n = 3, 4, 5, \ldots$
Diffuse series . .	$3P - nD$	$n = 3, 4, 5, \ldots$
Fundamental series .	$3D - nF$	$n = 4, 5, 6, \ldots$

where n is known as the *principal quantum number*. The actual numbering of the terms in modern form is based upon theoretical considerations.

As first recognized by Ritz and expressed in his *combination principle*, other terms of a sequence besides the first may combine with terms from other sequences to produce subsidiary series, as, for example, $4P - nD$. The possible combinations in ordinary circumstances, however, are restricted by selection rules, one of which is that only terms from adjacent sequences in the order S, P, D, F, G, . . . combine to produce lines.

Multiple Terms

When a family of series consists of doublets or triplets, the specification of the spectroscopic terms requires additions to the scheme for a singlet system. These are the so-called *inner quantum numbers*, j, which were empirical in the first instance but have since become of profound

* From the twenty-third Thomas Hawksley Lecture of the Institution of Mechanical Engineers, delivered on November 6, 1936.

theoretical importance. In modern form, the different types of terms are written as follows :

Singlet terms	$^1S_0$	$^1P_1$	$^1D_2$	$^1F_3$
Doublet terms	$^2S_{1/2}$	$^2P_{3/2}$	$^2D_{5/2}$	$^2F_{7/2}$
		$^2P_{1/2}$	$^2D_{3/2}$	$^2F_{5/2}$
Triplet terms	$^3S_1$	$^3P_2$	$^3D_3$	$^3F_4$
		$^3P_1$	$^3D_2$	$^3F_3$
		$^3P_0$	$^3D_1$	$^3F_2$

Here the index on the left of the symbol for each term indicates the multiplicity r of the system, while the suffix on the right is the inner quantum number j.

Terms of higher multiplicity than three occur in many spectra, giving quartets, quintets, sextets, septets, octets, or still greater complexities. Odd and even multiplicities, however, never appear together, but occur alternately in passing through successive groups of elements in the Periodic Table. As many as three systems may occur in the same spectrum. The names given to these higher multiplicities indicate the *maximum* number of j values assigned to any of the terms. S terms are always single, P terms have never more than three components, D terms not more than five, F terms not more than seven, and so on.

Under ordinary conditions, combinations between different terms in the same spectrum are subject to two further selection rules, namely, $\Delta r = \pm 2$ or 0, and $\Delta j = \pm 1$ or 0, with $j=0$ to $j=0$ forbidden. This means that terms cannot combine to produce a line unless the r values differ by 2 or 0 and the j values by 1 or 0. The first selection rule already mentioned is expressed as $\Delta l = \pm 1$, where $l = 0, 1, 2, 3, \ldots$ for S, P, D, F, . . . terms.

Bohr's Theory

The significance of series of lines in spectra had not begun to be understood until Bohr launched the epoch-making quantum theory of atomic spectra in 1913. The normal hydrogen atom was assumed to consist of a minute nucleus of mass M and positive charge E, with a single electron of mass m and negative charge e moving round it. When the atom was excited by the absorption of energy, the electron was supposed to traverse larger orbits, specified by the quantum condition that the angular momentum must be an integral multiple of $h/2\pi$, where h is Planck's constant. On the further assumption that a quantum of radiation $h\bar{\nu}$ (where $\bar{\nu}$ = oscillation frequency) was emitted when the electron returned from one orbit to another of lower energy, Bohr derived an expression for the hydrogen spectrum which is in agreement with that determined experimentally, and in which R took the form, $\frac{2\pi^2 E^2 e^2}{ch^3} \cdot \frac{Mm}{M+m}$, where $E=e$ for hydrogen and c is the velocity of light.

A *term* represented an energy state of the atom, giving no radiation, and a *line* the emitted radiation when the atom passed from a state of higher to one of lower energy. This has been found to be applicable to all atoms, and the different states are regarded as *energy levels*, quite irrespective of any particular model of the atom.

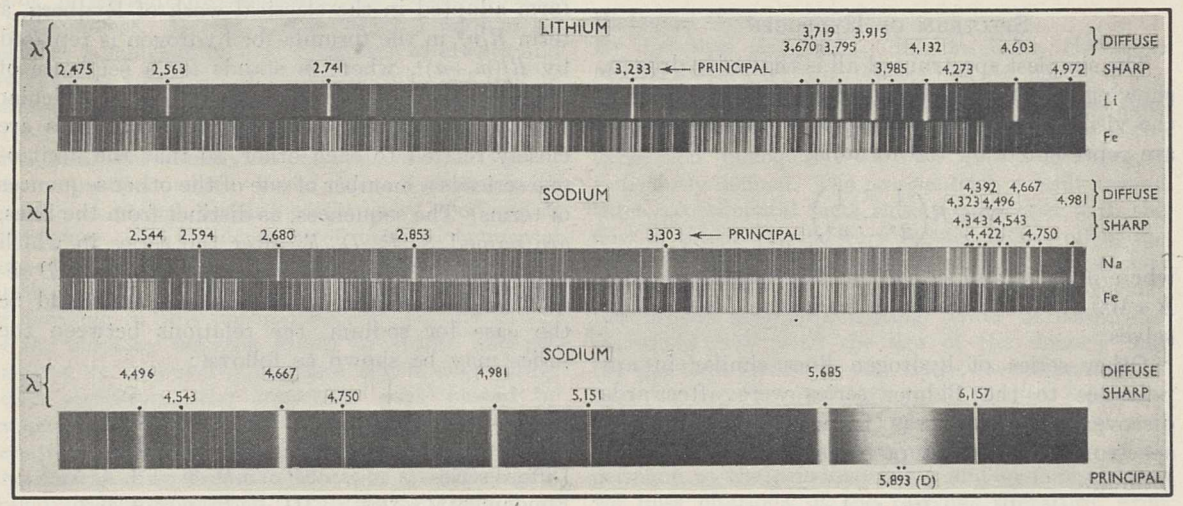

Fig. 1.

SERIES OF LINES IN THE SPECTRA OF LITHIUM AND SODIUM WITH IRON ARC COMPARISONS.

Ionized Atoms

Strong support for the theory was given by its application to the spectrum of ionized helium, which is produced by intense electrical discharges through the gas. This spectrum is developed when

the atom has lost one of its electrons, the remainder then being similar to a hydrogen atom, except that the nucleus has a double positive charge, and a mass four times greater. The spectrum should accordingly be similar to that of hydrogen, but relatively displaced, and this agrees with observation, even in quantitative details. Following this, it was foreseen that an atom of any element might be deprived of its electrons one by one through increasing excitation, and that the series constant would change through values of approximately $4R$, $9R$, $16R$, and so on, until, when only one electron remained, the spectrum would become similar to that of hydrogen. All this has been verified by experiment, and, as was expected, it has been found in general that when an atom has become ionized its spectrum resembles that of the element which precedes it in order of atomic number. If two electrons have been removed, the spectrum will resemble that of the element of atomic number $Z-2$, and so on indefinitely. It has been found convenient to represent the spectrum of a neutral atom by Z_{I}, and the spectra at successive stages of ionization by Z_{II}, Z_{III}, etc., the corresponding states of the atom itself being indicated by Z, Z^{+}, Z^{++}, etc.

A good illustration of the changing spectrum of an element is given by the photographs of silicon spectra reproduced in Fig. 2. The experiments were made on the vapour of silicon tetrafluoride in a vacuum tube, the intensity of the electric discharge increasing gradually from 1 to 6.

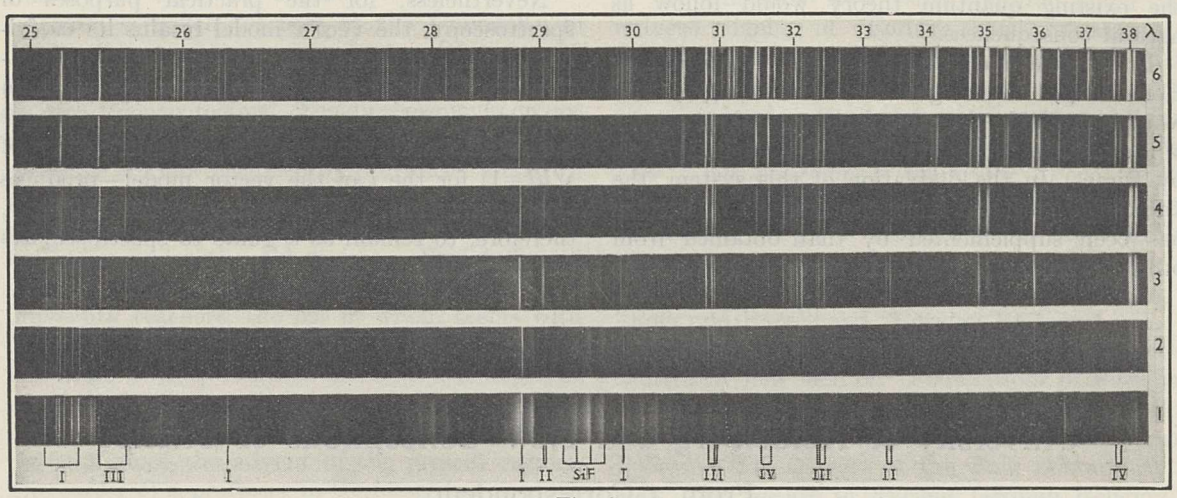

Fig. 2.

SUCCESSIVE SPECTRA OF SILICON PRODUCED BY GRADUALLY INCREASING INTENSITY OF DISCHARGE THROUGH A VACUUM TUBE CONTAINING SILICON TETRAFLUORIDE.

THE VECTOR MODEL

As the finer details of spectra were taken into consideration, the Bohr conception of the atom was found to require more elaboration. For an explanation of multiple terms, for example, it became necessary to suppose that the electron possessed a spin, the angular momentum of which, denoted by the quantum number s, was fixed at $\pm\frac{1}{2}$, according to the direction of rotation.

Despite such additions, however, it was ultimately realized that the orbital model was incapable of describing all the intricacies of spectra, and in more general considerations it was displaced in favour of a *vector model*, in which the various quantum numbers of the electron were no longer necessarily associated with orbits, but with angular momentum vectors the interpretation of which in the form of a picturable mechanism was not essential. In this model, five quantum numbers are used, n, l, s, j, and m, but only four of these are independent, since j is the quantized resultant of l and s. In the simpler cases in which the orbital model is adequate, these vectors correspond respectively with the quantum numbers n, l, s, and j already described; while the number m corresponds with the quantized projection of j along the magnetic axis of the atom. In the general case, however, although the names suggested by the orbital conception are often used, they cannot be applied with their literal meanings, and the quantum numbers are used in calculations merely as symbols obeying certain rules.

It is not possible here to enter into intricate details of spectra. It must suffice to state that on the supposition that an atom is so constituted that the angular momenta of all the rotary motions can only change by unit steps, a complete scheme has been worked out by Hund by which the types of terms associated with a given distribution of electrons around the nucleus can be

calculated. The results of such calculations are in entire agreement with the types deduced from the numerous analyses of spectra which have now been made.

Quantum Mechanics

These developments of the theory of atomic structure took place in intimate relation with spectroscopic research. The result was a conception of the atom, definite so far as application to experimental results was concerned, but containing basic *ad hoc* assumptions which violated the principles of classical mechanics. Throughout the development of the theory it was evident that some fundamental system of mechanics was required from which the assumptions of the existing quantum theory would follow as natural consequences.

The foundations of such a system were laid by Heisenberg, de Broglie and Schrödinger, and what is probably the most fundamental statement of the resulting quantum mechanics has been given by Dirac. In the derivation of this system, the knowledge gathered from the analysis of spectra has been supplemented by that obtained from other experimental work. It would therefore take us outside the scope of our subject to enter into these advances, and it only remains to indicate in general terms the reaction of quantum mechanics on the question of atomic structure. This may be summed up by the statement that, while the arbitrary postulates of the empirical theory have been expressed as necessary consequences of fundamental mechanical principles, the orbital picture and vector representation of the atom have been discarded, and no equally picturable substitute has been given. A partial picture is possible in terms of a rather indefinite distribution of electricity, one such distribution corresponding to each stationary state, or electron configuration, of the atom according to the earlier ideas. It is impossible, however, to locate the electron at a precise position in this distribution.

Nevertheless, for the practical purposes of spectroscopy, the vector model retains its usefulness. Many of the results obtained by its application are identical with those given by quantum mechanics, and where divergence occurs, a simple modification—as, for example, the substitution of $\sqrt{l(l+1)}$ for the l of the vector model—produces close agreement. The vector model is likely, therefore, to remain as a guide to spectroscopists for some time to come.

University of Heidelberg and New Conceptions of Science

From a Correspondent

THE general character of the changes in the German universities was expounded by Herr Rust, Reichsminister for Education, at the recent celebration of the 'jubilee' of the University of Heidelberg. His address is translated in the November issue of the *Universities Review*. Herr Rust believes the New Germany to be the true heir of Sparta and suggests that these changes are as though Sparta had triumphed over Athens. Had that calamity befallen the world, all that we could have inherited from Greece would have been 'discipline', for Sparta had no other gifts to bestow. But the new "Weltanschauung", Herr Rust assures us, "is the life-blood of a new science . . . National Socialism has provided science with new principles from which she can derive the strength of self-confidence. . . . The old idea of science based on the belief in the supremacy of the intellect is finished."

The effect on a university of the arbitrary treatment of its staff is not numerically expressible. Injustice to one teacher may overawe the entire faculty and deprive its work of all value. Staff changes at Heidelberg tell, therefore, of only a fraction of the injury to learning. We give, however, a summary of what has happened at Heidelberg; and it suggests what is going on throughout the universities of Germany.

The calendar of the University of Heidelberg for the academic year 1936–37 may be compared with that of 1932, the last year unaffected by the new regime. The historical account of the university, which opened previous calendars, is omitted this year. Any record of either benefactors or distinguished alumni would have to include names of many of Jewish or partly Jewish origin. The very title of the official head has been altered, and Rector Groh is now Führer Groh. The order and many of the titles of the staff are changed. After Führer Groh follows the *Leiter* of the body of dozents, Herr Schlüter, who, oddly enough, is not himself a dozent. Next is the undergraduate Herr Ernst Kreuzer, who is both a member of the Senate and "Officially designated Undergraduate Leader at

Heidelberg of the Nazi Student Union of the Nazi Party". (*Kommissarischer Hochschulgruppenführer der Hochschulgruppe Heidelberg des NSD Studentenbundes der NSDAP.*) After this student follow the deans and other members of the Senate. Six of the ten ordinary members and seven of the twelve deans and sub-deans were not members of the teaching staff in 1932. The academic authority that occupies the next place is the "Nazi Teachers' Union" (*Nationalsozialistische Dozentenbund*). Of this the "District Führer" (*Gaudozentenbund-Führer*) is Party Member Professor Dr. Ernst Krieck who, for a short time, held uneasily the rectorship of the University of Frankfort. The promotion of Dr. Krieck, not long ago teacher in a *Mittelschule*—that is what we should call the 'modern side' of a secondary school—has been very rapid.

There were 215 teachers at the University in 1932. There are now only 180*. Of these, 99 survive from the old regime, while 81 have come in with the new regime. The displacements do not imply promotion. On the contrary, many higher positions are now occupied by previously unknown men, and some by men who hold, in addition, ministerial office (*Ministerialrat*), a combination forbidden under the old regime. Nazi influence is most evident, however, in the lower ranks of university teachers, the list of whom teems with 'Party Members'. A few teachers have been permitted to keep nominal positions but deprived of stipend. Among those dismissed are, remarkably enough, a number who have been added to the staff since the advent of the present regime. The career of a professor in Germany has become, like the life of Hobbes's primitive man, "poore, nasty, brutish and short".

The actual causes of dismissal have not been published, and to ascertain them with accuracy would involve a long and a dangerous research. In the majority of cases doubtless the victim was a Jew or had some more or less distant Jewish affiliations. Nevertheless, in the Faculty of Medicine, where dismissals have been most numerous, only half of the dismissals seem explicable on such grounds. "Political unreliability", that is to say, connexion with any 'left' party before the advent of the present regime, or want of submissiveness to the present regime, is a common cause of dismissal. It is difficult to say in how many cases dismissal has been produced or stimulated by direct action by the students. These have violent national socialist leaders, and there can be no doubt that they have had and have a large share in the control of the University.

* The number of teachers is approximate. As in an English university, many members, for example, librarians, junior demonstrators or physical instructors, belong doubtfully to the teaching staff. The figures 215 and 180 are conservative.

The constitution of the reduced staff may be learned from the following table:

Faculty	Percentage of new appointments
Science	31
Theology	36
Law	38
Philosophy	49
Medicine	56

The changes in the Faculty of Law are peculiarly significant. The Institute for Historical Jurisprudence has lost its former name "Rudolf-Mosse-Stiftung", which indicates that it is a Jewish benefaction. The Jewish endowment is retained. Important fields of legal knowledge are no longer represented. In the list of 1935–36 the subject of "International Law" still appeared under the reduced dignity of "Foreign Law" (*Ausserstaatliches Recht*) to be expounded by one undesignated. In the current list it has vanished and left not a wrack behind. A subject which makes its first bow to the learned public is "Reform of the Penal Law", but no room is found for "Penal Law" itself. The hand of the secret police is here discernible. Special instruction is provided in "Recent Political History", "Folk Elements in Law" (*Rechtliche Volkskunde*), "Family Heredity", "Folk and Race", and "German Military Law".

In the Philosophical Faculty there are new courses by new men on "Foundations of National Socialist Philosophy" as well as on "Folk Philosophy", "German Philosophy", "Educational Policy", "The Nature of the Folk Community", and "The Nature of Ancient German Religion". The Philosophical Faculty has now a new "Professor of Modern War History". His work would seem to overlap that of Herr Minister Schmidthenner, who is "Professor Ordinarius of History with special reference to the History of War and Military Knowledge" (*Wehrkunde*). Herr Professor Minister Schmidthenner will lecture on "The World War", "Politics and War Leadership", "The Total War", "Germany's Right to Colonies" and on "Political Geography of the German East". He holds a seminar on "Being and Action of the German Soldiery".

In the Faculty of Science the following are among the dismissed: the two ordinary professors of mathematics, Liebmann and Rosenthal, the professor of geology, Salomon-Calvi, honorary Professor Victor Goldschmidt, Extraordinary Professors Merton (Zoology) and Gerta von Ubisch (Genetics), Privatdozents Lemberg, Wolf and Schmitz. There is now no ordinary professor of mathematics at Heidelberg. Many courses in mathematical subjects are suspended or advertised as by teachers as yet undesignated.

In the Faculty of Medicine the dismissals have been very numerous. Among them are Ordinary Professors Baeyer, Bettmann, Blessing, Sachs, Willmanns; Honorary Professors Fränkel and Löwe; Extraordinary Professors Gruhle, Gyorgy, Klopstock, Meier-Grosz, Münter, Schreiber, Serr, Steiner, Zade; Privatdozents Laser, Pagel, Stern, Strauss, Wittebski and Wurm. Nearly the whole of the cancer research staff has been dismissed. The first medical lectures advertised are "Nazi Philosophy and Race Theory", "Folk and Race", "Medical Outlook on Physical Development", "First Aid with special reference to Military Sport and Gas Defence".

We cannot discuss student life at Heidelberg, but note that before matriculating a student must produce documentary evidence of the religion of both of his parents and of his four grandparents. The recession of learning and the significance of propaganda in the life of the University is revealed in the programme of the official "Students' Faculty Discussion Groups" (*Arbeitsgemeinschaften*). Subjects for debate there are "Self-consciousness of German Culture", "Education of Nazi Youth", "Labour Service and Military Law", "Claims of the Germans in Czecho-Slovakia", "Laws concerning Race", "Care for Healthy Inheritance", "Eastward Expansion of Germany", and "Professor Lenard and his Significance for German Science".

Faced with a series of unprecedented attacks on the interest of learning as well as on their own rights, no member of the staff has had the temerity to utter any word of public protest. There are several retired or very senior members of independent standing from whom one might have reasonably hoped for some sign of courage. But Germany has openly reinstated serfdom, the essence of which is to restrain the worker from marketing his labour as he will and to place him at the disposal of an overlord. It is, therefore, appropriate that the minds of Germans should be enslaved along with their bodies, for slavery mercifully provides its own spiritual anæsthesia. This, in truth, is the 'new principle' for science which Reichsminister Rust has discovered. But, to speak yet more plainly, science has been abolished in the German universities and its spirit has abdicated from the Reich.

Obituary Notices

Dr. A. A. Robb, F.R.S.

ALFRED ARTHUR ROBB, who died on December 14 at the age of sixty-three years, won distinction by his contributions to the theory of relativity during the early period of its development. His life-work is contained in a book "A Theory of Time and Space" first published in 1914; it is a happy circumstance that he lived to complete a revised edition which appeared a few months ago. This work consists of an axiomatic and logical development of the geometry (Minkowskian geometry) of the space-time of special relativity theory, arranged as a sequence of more than two hundred theorems. It is generally recognized to be a model of its kind.

To the analyst, the difference between Euclidean and Minkowskian geometry seems trivial, being merely the substitution of an imaginary for a real variable in one of the co-ordinates; but the formal simplicity of the change often causes insufficient attention to be paid to its implications, so that serious misconceptions arise later on. In an axiomatic treatment, the two geometries show little resemblance to one another; in particular, Robb's theory could not be applied to Euclidean space, nor could anything even remotely analogous be substituted. His work shows more clearly than any other how by dissecting space-time into spatial sections we lose the very essence of its constitution. Robb developed his theory on the sole basis of an irreversible relation of 'before' and 'after', which, as he pointed out, is simpler than the spatial relation of 'between'. This leads to the study of a type of order of points which he called 'conical order'. His work, which he attributed to the inspiration of Sir Joseph Larmor, was partially independent of that of Einstein and Minkowski; and, coming at a time when their theories were little known or discussed, it has been very helpful in elucidating the paradoxes that seemed to arise.

There was an unusual combination of the abstract and the practical in Robb's mental outlook. He took great trouble in designing models to illustrate his theory. Apart from relativity, he was interested in geometry and mechanics, not in a systematic way, but on the look-out for neat devices, subtleties and curiosities. He delighted in exposing the traps which catch unwary text-book writers, and was rather merciless to the victims. It was difficult to persuade him that a man might have a sound understanding of relativity in spite of his having described a geodesic in space-time as a track of minimum (instead of stationary) length. He was no less severe on those who too unguardedly assert the equivalence of electric circuits and magnetic shells, producing to confound them the example of a circuit bounding a surface which has only one side. But if he had to some extent the 'gadget mind', he had also exceptional critical insight and logical power. To discuss a problem with Robb was most stimulating; and

he seldom failed to find some new angle leading to clearer vision. Being shy and reserved, he made comparatively few friends; but those whom he had, found him a most entertaining companion. They appreciated also his extreme conscientiousness and sense of duty. He was a man of strong convictions, which he urged with pugnacity tempered by a delightful sense of humour.

No account of Robb would be complete without reference to his gift for writing topical verse and parody. He wrote many of the songs sung at the annual dinners of the Cavendish Society. His feat of adapting Maxwell's equations as the chorus of a song must have earned the gratitude of many who, like the present writer, could never remember them otherwise.

Robb was a thorough Irishman, in voice, appearance and sentiment. Though his home and family connexions were in Belfast, his sympathies were generally with the South. After passing through Queen's College, Belfast, he became a research student at St. John's College, Cambridge; he afterwards studied at Göttingen, where he took a Ph.D. degree. Being possessed of independent means, he never sought a post; but his habit was to spend most of term-time in Cambridge, living very quietly in lodgings, seeing a few old friends, and mainly occupied with mathematical research.

When the Great War came, Robb voluntarily undertook chemical work in connexion with the supply of medical drugs. But after some time his suspicions were aroused, and being unable to obtain an assurance that his products were not intended for the production of poison gas, he resigned. Not to be deterred from medical service, he learned to drive a motor-car and served as an ambulance-driver in France. In later years he joined Emmanuel College and was made a member of the High Table. Sometimes by invitation of the Faculty Board of Mathematics he gave a course of lectures on his theory. He was elected to the Royal Society in 1921.

This quiet academic life was rudely broken about five years ago, when Robb was called by circumstances to assume the management of his family business—an important firm in Belfast. Through a series of deaths of near relations, he was left almost the sole adult representative of his family, and it depended on him to keep things going in the interests of the next generation. For him it was a most uncongenial change; but he appears to have adapted himself to it successfully. He retained his rooms in Cambridge, hoping to find opportunity to return; but his visits have been rare. The new edition of his book, which contains considerable changes, is evidence that he remained active in mathematical research up to his death. A. S. E.

Sir Henry Hall, I.S.O.

IT is with great regret that we have to record the death of Sir Henry Hall, who died at Brookside, Chester, on December 8, at the ripe age of ninety years; he was born, therefore, in 1846, and was the youngest son of Mr. John Hall, of Sedgefield, Co. Durham. He served his time at the old Haswell Colliery Co., Durham, and got an appointment in the Swansea district in 1873. About 1875 he was appointed inspector of mines in that district, and was afterwards transferred to Lancashire, and was in addition given the care of North Wales when districts were reorganized a few years later (about 1910).

According to his own account, an accident at Wynnstay Colliery, North Wales, about the year 1874, first directed Sir Henry's attention to the danger of coal dust, and in 1890 he was appointed to experiment on the subject by the Royal Commission, which sat under the Right Hon. Joseph Chamberlain, M.P., as chairman, and consisted of a number of men well versed in explosions and mining, who altogether examined thirty-nine witnesses. According to his own statement, three different collieries were experimented on, in shafts ranging from 50 yd. to 200 yd. deep, and in a gallery some 45 yd. deep, using dust from the various districts of the country and no firedamp. It was not a new idea of Mr. (as he then was) Henry Hall's, the original idea being due to Faraday and Mr. Lyell, according to Mr. Godfrey Lushington (in Answer 66) in 1844. It was then revived by Mr. William Galloway and Messrs. W. N. and J. B. Atkinson, in which an explosion in a hopper, where no firedamp was present, was cited.

Mr. Henry Hall's results were accepted by the industry, but his remedies for this state of affairs, namely, watering and the use of high explosives (not gunpowder), were not followed up, because watering was not a complete remedy and often produced 'creep', and Sir William Edward Garforth's further experiment on the use of stone dust, finely divided, has been accepted by the industry in general and is now confirmed by legislation. The remedial suggestion decidedly advocated by Mr. Henry Hall was the use of the safety lamp, according to Mr. J. B. Atkinson, which has since been made compulsory by legislation.

For this service and his numerous papers read before the North of England Institute of Mining and Mechanical Engineers, and before the Institution of Mining Engineers—these among other services to the mining industry—Hall was given the medal of the Institution of Mining Engineers in 1928, whilst he was awarded the Imperial Service Order, and afterwards received the honour of knighthood. His death removes a man whose name is a household word in the mining industry, and who has ever, even after his retirement from the inspectorship, taken the keenest possible interest in the industry.

Dr. E. S. Cobbold

THE ranks of the amateur geologists have been seriously thinned by the death of Edgar Sterling Cobbold on November 20, in his eighty-sixth year. The son of a surgeon who was greatly interested in natural history, he studied engineering at the Owens College and, after some fifteen years' practice, retired to Church Stretton in 1886. Here he at once threw

himself into the study of the district, taking an active part in the proceedings of local natural history societies, and contributing extensively on archæology and geology to both scientific and popular guides to the area.

Cobbold's first contribution to geology here was the description of a Silurian outlier of much tectonic significance under Caer Caradoc. He soon came under the spell of the thoroughness and accuracy of Charles Lapworth's work, and became infected with his enthusiasm for the ancient rocks. Lapworth's discovery of the *Olenellus* fauna in Shropshire, and Groom's find of *Paradoxides*, having demonstrated the existence of Lower and Middle Cambrian rocks in the Stretton and Wrekin areas, Cobbold proceeded to collect from these rocks inch by inch. His reward was the discovery of many forms new to Great Britain and to science. He described a dozen new genera and more than a hundred new species from them, and was able to divide the Lower Cambrian into eleven, and the Middle into nine divisions, mostly definite life zones.

Thus Cobbold made his area the type-section for Britain, correlated the rocks with those of America and the Continent, and demonstrated the existence of breaks in the sequence caused by earth movements. He became our leading authority on Cambrian faunas, and was called in by the Geological Survey to determine the fossils collected by himself and others from the considerable Cambrian area between the Wrekin and Charlton Hill. His type-fossils have been lodged in the British Museum, the Geological Survey Museum, or the Sedgwick Museum.

The work that Cobbold accomplished with such conspicuous success could only have been carried out by one living on the spot, with abundant leisure and the knack of using it effectively, with remarkable energy, industry, devotion, and perseverance, with wide knowledge of his subject and its literature in many languages, and with the hand and eye of an artist. W. W. W.

We regret to announce the following deaths :

Mr. Thomas Crook, O.B.E., since 1928 principal of the Mineral Resources Department, Imperial Institute, London, on January 6.

Mr. P. A. Ellis Richards, president of the Society of Public Analysts in 1922–23, aged sixty-eight years.

Sir David Semple, founder and first director (1900–5), of the Pasteur Institute of India on January 7, aged eighty years.

News and Views

Prof. E. B. Bailey, F.R.S.

THE Lord President of the Council has appointed Prof. E. B. Bailey, professor of geology in the University of Glasgow, to be director of the Geological Survey of Great Britain and of the Museum of Practical Geology, a post rendered vacant by the untimely death last year of Dr. Bernard Smith. Prof. Bailey previously served on the staff of the Survey for some twenty-seven years. After a distinguished career at Cambridge, where he gained the Harkness scholarship in geology, in 1902 he was appointed geologist to the Geological Survey of Scotland, with headquarters in Edinburgh, where he remained until 1929. During the years he served in Scotland, Prof. Bailey made a special study of the tectonics of the Dalvadian schists, a subject in which he became an acknowledged leader. He also took an important part in the survey of the tertiary igneous rocks in Mull, and edited the Survey memoir on this area. Other duties carried out during his years on the Survey included much work on the Carboniferous rocks in the Midland Valley of Scotland. His experience was further widened by visits abroad from time to time. Prof. Bailey's Survey career was interrupted by the Great War, during which he saw much service in France with the Royal Artillery, receiving the Military Cross, the Legion d'Honneur and the Croix de Guerre as rewards for distinguished services. His enthusiasm for geology was such that he even found time to publish papers on this subject during the time he was engaged on military service.

IN 1929, Prof. Bailey resigned from the post of district-director in Scotland, to take up his appointment to the chair of geology in Glasgow. During his tenure of this post, he has continued his researches into Highland tectonics, and has also developed the application of current- and graded-bedding to the question of the age of the Highland schists. Among the academic and other distinctions received by Prof. Bailey may be mentioned the following : from the Geological Society of London, in 1923 the Bigsby Medal, and in 1935 the Murchison Medal ; in 1928, president of Section C (Geology) of the British Association ; in 1930, elected fellow of the Royal Society ; in 1936, awarded the honorary degree of D.Sc. by Harvard University at its tercentenary celebration. The results of the official work carried out by Prof. Bailey, and of his private researches, are contained in numerous memoirs of the Geological Survey, and in the publications of various learned societies. He is also the author of "Tectonic Essays : Mainly Alpine".

The Piltdown Jaw

IN another column of this issue of NATURE (see p. 120) reference is made to the reaffirmation by Prof. F. Weidenreich of the Cenozoic Research Laboratory, Peiping, of the orang-like character of the Piltdown jaw, which he relegates to the group orang-chimpanzee-gorilla, standing outside the line of human descent. In this connexion attention may be directed to another attack on the human character

of the Piltdown relic by Mr. Alvan T. Marston, which appears in *Discovery* of January. Here the basis of argument is the character and arrangement of the teeth, in which it is maintained the jaw is anthropoid and not human. The form of the canines, it is said, points to a gap between canines and incisors and an outside bite of the former, such as are found in the apes, but never appear in man, even in such an early and primitive form as Peking man. Similarly, such indications as are afforded by the Piltdown jaw on the order of eruption of the teeth point to the anthropoid, rather than the human, character of the dentition. The canine, instead of preceding the second molar, as in man, was here the last to erupt, and indeed, Mr. Marston infers, was still incompletely formed. Further, he concludes, the jaw shows no evidences of the adaptations for speech, for which capacity is to be inferred from the advanced character of the brain. When Prof. Weidenreich's promised monograph on the teeth of *Sinanthropus* appears, in view of the relatively large amount of evidence at his disposal, it may be anticipated that we shall learn whether the teeth show the variability, which he has found in the mandible, and whether it supports the evidence already available to Mr. Marston, on which he relies to no little extent in stating his case.

France and its People

IN "France : a Handbook for Beginners in French" (Cambridge : W. Heffer and Sons, Ltd. Pp. 48. 1*s*. net) are reproduced three lectures by Dr. Cloudesley Brereton, originally broadcast in Great Britain in December 1935 and January 1936 and afterwards repeated, at the invitation of the French Government, from Paris. The sub-title, in so far as it may tend to suggest that the pamphlet is unlikely to appeal to the general public, is misleading, for here is no mere catalogue of dry facts but a lively appreciation of the genius, to quote the author's own words, of a hard-working, cheerful, amiable, keen-witted, polished, social, artistic and, at bottom, spiritually-minded people. That it is eminently fitted to promote that mutual understanding and appreciation between nations which a strident modern nationalism threatens to stifle has been recognized by the judges entrusted with the awarding of the recently instituted "Prix internationaux du Tourisme". They have awarded to the author the second prize of 15,000 francs ; the first prize, of 25,000 francs, having been awarded to Mrs. Brangwyn, an American, for "Everybody in Paris". As an example of Dr. Brereton's method may be quoted his comparison between French and English science teaching in secondary schools. Practical science is, he holds, rather neglected in the French *lycée*. "In the more abstract side of science, however, a very high standard is attained. Our schools possibly err in the other direction—somehow the glamour of science has rather been overshadowed by the excessive cult of the test tube in this country".

Archæological Expedition to Nubia

SIR ROBERT MOND'S appeal on behalf of the archæological expedition to Nubia projected by the Egypt Exploration Society merits, and no doubt will receive, full measure of support. The valuable work of investigation which the Society has carried out at Tell el-Amarna under its present concession from the Egyptian Government, on a site which might have been thought already to have yielded its precious material to the excavator, is a warrant that the expedition will spare no pains on the new sites to secure that nothing of moment is overlooked which may throw light on the history and culture of this little-known part of ancient Egyptian rule. As Sir Robert points out in his letter to *The Times* of January 4, the two sites which have been reserved provisionally for the Society, Sulb (Soleb) and Sesebi in Upper Nubia in the region of the Third Cataract of the Nile, will both throw further light on the Amarna age, upon which the Society has been engaged now for some years. Their comparative inaccessibility accounts for the fact that they have been little studied ; but it is known that at both these fortress cities there are remains which date from the reigns of Amenophis III and Akhnaton. The temple of Sulb is in fact described by Breasted, as quoted by Sir Robert, as "the most important monument surviving in the Sudan, and one of the two greatest architectural works surviving in the Nile Valley, the other being the temple of Luxor . . . We have in Soleb, therefore, one of the first creations of the Empire". As the temple has on its walls running reliefs which depict scenes from the Sed festival, to celebrate which Amenophis caused this temple to be built, its investigation will supply information as to ritual and belief which is unique. Further, as the two fortresses probably occupied the sites of earlier Nubian towns, some data, at least, should be forthcoming bearing upon the earlier population of Nubia, which, it will be remembered, the late Sir Grafton Elliot Smith held to be of considerable moment in the understanding of the early racial history of ancient Egypt.

Academy of Natural Sciences, Philadelphia

IN the course of the current month, the Academy of Natural Sciences, Philadelphia, will issue invitations to an international symposium on early man and the origins of the human race which is to be held in Philadelphia on March 18–20. This symposium will form part of the proceedings celebrating the one hundred and twenty-fifth anniversary of the foundation of the Academy. Among those who have already promised to contribute to the symposium are Dr. P. Teilhard de Chardin of China, Dr. Ralph von Koenigswald of Java, Dr. R. Broom of South Africa, Miss D. A. E. Garrod of Great Britain, and Dr. Kaj Birket-Smith of Denmark. The arrangement of the programme is in the hands of a committee which includes Dr. John C. Merriam, president of the Carnegie Institution, Washington, D.C., Dr. Edwin C. Conklin, vice-president of the Academy and president of the American Association for the Advancement of Science, Dr. George G. MacCurdy, director of the American School of Prehistoric Research, Dr. Hellmut de Terra of the Carnegie Institution and Dr. E. B. Howard,

acting curator of the Academy's Department of Geology and Palæontology, who will act as secretary of the Committee. An attraction additional to the original papers which will be presented at the symposium is a "Hall of Prehistory" in which will be represented all the fossil remains of early man and his weapons and tools, as well as replicas of the principal sites of discovery. Among the exhibits for which arrangements have already been made is a cast of *Homo Modjokertensis*, the recent discovery from Java, which has been claimed to be "the earliest datable human fossil". This will be exhibited by Dr. von Koenigswald. Dr. E. B. Howard will be responsible for a reproduction of the site of Folsom man at Clovis, New Mexico, and casts of the recently discovered relics of Peking man will be shown by Dr. Teilhard de Chardin.

Wool Industries Research Association

AN apologia on a research association's work and policy is an unenviable task for any of its officials to essay. Mr. Wilsdon, director of the Wool Industries Research Association, in his recently issued annual report, has frankly stated those especial difficulties which beset his and other research associations in endeavouring to establish and increase the confidence and support of its members, whose subscriptions are on a voluntary basis, whose individual interests are widely divergent and, with the many subdivisions of the industry, even competitive, and whose expectations, apart from some particular information yielding direct financial benefit, are largely nebulous in character. Such associations are for these reasons an easy mark for destructive criticism, always louder than the praise for specific individual benefits, which is too often uttered unobtrusively, if at all. Standardization, on which Mr. Wilsdon rightly puts insistence, has an undoubted place within this, as other, industries. There is also much to be said in favour of pooling information for the general raising of manufacturing excellence; but there are limiting factors which make the effective bounds much narrower than in most manufactures. As the architect puts his individual skill and experience, as well as his knowledge of fitness of material, design and colour, into the creation of the structure, so is cloth-making largely a 'creation' in this sense. The devising of woollen blends and of worsted tops is of similar complexity, and such circumstances tend to narrow the field within which the personal factor can be replaced or even checked by scientific classification.

ON the other hand, the trade should give wholehearted adherence to the dictum that "research on the fundamental properties of the wool fibre is the surest way of maintaining its pre-eminence among the textile fibres". Of the two discoveries referred to, the neutral bleach and the new unshrinkable process for wool initiated by Prof. A. T. King, of the University of Leeds, while chief chemist of the Association, the latter now promises to take front rank in modern textile developments, but might well have languished in face of incredulity and prejudice in some quarters. The Director of Research and his committee are to be congratulated on having brought it to the point of imminent release, against the considerable inertia which revolutionary changes have to overcome. Discoveries of this kind, however, which cannot be expected to occur frequently, should not, as Mr. Wilsdon has cogently reasoned, constitute the only means of bringing conviction to the trade of the Association's usefulness.

Artificial Thallium Moult in Sheep

IT has been known in medicine since 1898 that thallium compounds taken internally will cause loss of the hair. This method has recently been used to produce moulting of the fleece in sheep, instead of shearing. Prof. N. A. Iljin (*J. Genet.*, **33**, No. 2) gives a short account of experiments in which the sheep's fleece becomes loose a few days after treatment and can be removed whole with the hands in a few minutes. Sheep with coarse and mixed wool have a natural annual moult which is absent from fine-woolled breeds such as the merino. Hybrids are found to exhibit segregation of this character of natural moulting. By thallium treatment, the moult may be induced in merinos and their naturally non-moulting hybrids. Extensive experiments with this method have been carried out on Soviet State Farms in the Crimea, Ukraine, Caucasus and the Moscow district, but as a considerable number of sheep were killed by an overdose during the experiments, it is evident that the effects of repeated doses on the animal will need to be known before the treatment can come into practical use.

Development of Crystal Analysis

SIR WILLIAM BRAGG, delivering the Sir Henry Trueman Wood lecture before the Royal Society of Arts on December 16, gave an account of the development of crystal analysis by X-rays during the last decade. The X-ray data may now be made to give a 'shadow picture' of the molecular structure which can be compared with chemical ideas of structural grouping. The dimensions of the structure can be determined with very considerable accuracy—the separation of atoms within about one per cent—and it is found that the characteristic separation of, say, carbon atoms persists in a number of related structures. Chemical ideas of valency, double and triple linkages, the benzene ring are all clarified by this method of study of the atomic separations. The investigation of structures is progressive in the sense that the information already gained can be used in the attack on more complicated structures. Important results have been obtained with proteins, and the properties of the protein chain explain the peculiarities of hair, muscle and similar biological structures. The X-ray diffraction patterns obtained from alloys show how a small quantity of an alloying element fits into the main lattice; while the progressive addition of alloy leads to the formation of new, characteristic lattices. The peculiar alloy structure called the γ-phase depends apparently on a fixed

proportion (13:21) of atoms to valency electrons. X-rays, aided by electron diffraction, also give information about the crystal texture—the size and arrangement of the crystals as distinct from their inner structure; and the texture is the key to such different problems as the working of metals and the function of biological structures.

The Boulder Dam and its Equipment

IN *Engineering* for January 1 is a well-illustrated introduction to a series of articles which will deal with the mechanical, hydraulic and electrical features of Boulder Dam. These articles will be written by Mr. P. A. Kinzie, Mr. J. A. Winter and Mr. L. N. McClellan, who have each been responsible for some part of the equipment for the control and utilization of the water impounded by the Boulder Dam, which is not inappropriately described as "the greatest engineering effort of its kind in history". It was on December 21, 1928, that President Coolidge signed the Boulder Dam Act, which provided for the construction of a great dam on the Colorado River. The scheme had several objects. First, it was intended to prevent the serious floods which menaced the fertile district of the Imperial Valley; secondly, to conserve water for use in the same district during the hot dry summers; and thirdly, to provide a public water supply for the coastal cities of Southern California. The river has a length of approximately 1,700 miles, and drains an area slightly more than double the area of Great Britain. The site for the dam was chosen in Black Canyon about 300 miles upstream from the river mouth, a barren and inhospitable region, the character of which is well shown by the photographs in *Engineering*. The dam itself was completed in the summer of 1935. From the lowest portion of the foundation to roadway level it is 726 feet high; it is 660 feet thick at the base and 45 ft. thick at the crest, and contains about 6,600,000 tons of concrete. It is composed of massive vertical columns about 230 in number, interlocking both vertically and horizontally. Recently, the water impounded in the reservoir, Lake Mead, was estimated at ten billion gallons.

Electric Supply in Palestine

AN account of electric supply in Palestine since it was initiated in 1923, given in *Electrical Industries* of December 2, is of special interest in connexion with the political rioting which began last April. The pioneer of this supply was Mr. P. Rutenberg, who enlisted the support of the late Lord Melchett and the Baron E. de Rothschild. It was decided to have a national power supply from water-power, but as the rainfall for Palestine lasts only four months in the year, it was necessary to store the winter rainfall in reservoirs, the construction of which would take several years. It was advisable therefore to use temporary Diesel engine power stations at Haifa and Jaffa to begin the supply, whilst the Dagania dam across the River Jordan and the large one on the Tarmuck River were being constructed. In addition to these dams, Lake Tiberias, which forms a natural reservoir with a surface of 170 million square metres, was utilized. The water-power is converted into electrical power which by high-pressure electricity is distributed to Haifa and thence to the north and south of Palestine. In addition, a steam turbine power house was constructed in 1935 and a large power house called the 'Reading' (after the late Marquess of Reading) is being built in southern Palestine.

WHEN these plans are completed, the Holy Land will be as highly electrified as any territorial area in the British Empire. During the last three years, the consumption of electricity has quadrupled. There can be little doubt that industrialization is rapidly changing the character of Palestine and that electric power is the main factor in producing this change. Electric lighting, electric power driven machinery and all-mains wireless sets are to be found in small towns, villages and even in remote farming settlements. This is partly due to the fact that the immigrants who come from Germany, America, Czechoslovakia, Austria and the British Dominions, have been accustomed to the use of electric light in factory and home. It looks as if schemes for flooding the Dead Sea from the Mediterranean and so getting electric power possibly for sale to Egypt will soon be considered. One very beneficial effect would be that the constant evaporation from the greatly increased surface of water would humidify the atmosphere and so contribute to the fertility of the region.

Academic Freedom

THE report of the Conference on Academic Freedom at Oxford in August 1935 and the publication entitled "The Frustration of Science" form the text of a fine plea for academic freedom by M. J. Pelseneer in *Revue de l'Université de Bruxelles* of October–November. M. Pelseneer refers again to the various directions in which academic freedom is threatened and to the necessity for organized united resistance to those threats, and he emphasizes the way in which the freedom of the intellectual is linked up with the freedom of mankind. True liberty of thought is that which liberates mankind from the indignity of bondage. In particular, he pleads for tolerance in the matter of university appointments in the sense not merely of respecting the opinions of others but also in allowing them reasonable opportunity of expression. In this connexion it is interesting to note the conditions in the University of Heidelberg as set out on p. 98 of this issue of NATURE. M. Pelseneer, recognizing that human society must look to science for just laws and rational organization, even if their application to the distribution of production and government involves a social revolution, suggests that even within the limits of a given economic system, it is still worth while to discover the means of securing the minimum frustration of science.

Human Welfare and Human Efficiency

THE relation between industrial and social efficiency, discussed in a leading article in NATURE of October 3 dealing with Sir Josiah Stamp's address to the

British Association at Blackpool, has been further considered by Mr. W. H. Smyth in the *Berkeley Daily Gazette* of December 5. Mr. Smyth, protesting against the mechanical conception of efficiency, urges that ultimate human efficiency should imply the liberation of man rather than the efficient control of his actions, and that the former as it gains the creative interest of the worker is likely to be the best way of achieving, though indirectly, the latter. He suggests that an act of efficiency which deals with the human element incidentally but with products as its first consideration may inevitably involve disaster to the human element. The art of efficiency in fact is misdirected if it is concerned with production as an end in itself instead of with the development of men possessing vital initiative and creative powers. Mr. Smyth sees the issue as one between human worth and human productive efficiency and one that has a vital bearing on the evolution of alternatives to war. The very value which is now attached to the work of the National Institute of Industrial Psychology in reducing labour turnover, for example, lends powerful support to Mr. Smyth's other pleas that, even in industry, efficiency should be regarded in terms of human welfare as well as of mechanical output and processes.

Citizenship and the Universities

SHOULD training for citizenship be an integral part of every undergraduate's curriculum ? One of the smaller New England colleges, Hobart, announces a reorganization implying an affirmative answer to this question. Furthermore, the College hopes to make the bachelor's degree "represent less an aggregation of academic achievements and more an integration of intellect and of personality in the primary responsibilities of the citizen towards his community". The announcement is significant, according, as it does, with a growing tendency in the United States to emphasize the universities' obligation to the social order. In his inaugural address, published in *School and Society* of October 24, the president of the College explains that studies in economics, history, political science and social psychology will in future be so organized as to constitute a progressive four-year course culminating in its final year with a study of contemporary problems in American government and the means of social control. He points out that the 'orientation' courses commonly provided in colleges for the freshman year are well enough for opening the adolescent mind to a glimpse of the problems of the modern world, but are necessarily superficial and elementary compared with what is possible in the fourth year when the student has been equipped with a fairly comprehensive background of knowledge and is ready to envisage political and economic problems with interest as prospective factors in his own life. The dire need of the country for such stiffening as these reforms are calculated to provide is indicated by the statement that "Ballyhoo, the present and audible substitute for rational leadership, is well on the road to becoming the chief creator of American policy and politicians".

The National Botanic Garden of South Africa

KIRSTENBOSCH, part of the Groot Schuur Estate at Cape Town, South Africa, bequeathed to the nation by Cecil Rhodes, was set apart in 1913 for the purposes of a National Botanic Garden. The report of the Trustees for the year 1936 (issued August 1936) shows that, in spite of its small financial resources, a very gratifying amount of botanical, educational and economic work has been done. The objects of the Gardens are "the collection, cultivation and study of the indigenous flora of South Africa ; the preservation of the native vegetation of the areas under control ; and the introduction to cultivation in South Africa of selected economic plants, indigenous and exotic, and their preliminary trial". During the year under review, sixteen new species have been described, and many papers have been published. Large quantities of seeds of various species have been distributed to members of the South African Botanical Society and other institutions and the trade, and more than 200 lots of succulent plants have been propagated. Perhaps the Gardens' most useful activity is shown by the announcement that 1,108 lb. of *Barosma betulina* has been harvested, and also 102 lb. of *B. crenulata*, 1 oz. of Dalmatian insect powder flowers, 6 lb. of sumach, and 3 lb. of tansy—products which could be brought within the channels of commerce. Trials of lawn grasses are in progress, and many additions of fresh plants have been made to all parts of the garden. The report shows that the Gardens interpret every aspect of the flora of South Africa in a marked degree. Mr. F. W. Thorns has been appointed curator of the Garden, in succession to Mr. J. W. Mathews, who has held the post of curator since the foundation of the Garden in 1913.

British Empire Cancer Campaign

AT the sixty-first quarterly meeting of the Grand Council of the British Empire Cancer Campaign held at 12 Grosvenor Crescent on January 11, the following grants, in addition to those totalling £28,995 which were made at the annual general meeting in November, have been approved on the recommendation of the Scientific Advisory Committee of the Campaign : £200 to cover the cost of special physical investigations being carried out under the direction of Dr. F. G. Spear at the Strangeways Research Laboratory, Cambridge ; £500 for one year to Dr. H. J. Phelps, whilst carrying out experiments in connexion with Dr. Lumsden's anti-cancer serum under the supervision of Dr. Gye and Prof. McIntosh and £440 for one year to Miss C. F. Fischmann working in the Bernhard Baron Institute of Pathology at the London Hospital.

Tibet Earthquake of January 7

A GREAT earthquake was recorded in Great Britain at about 1.31 p.m. on January 7. At West Bromwich, as Mr. J. J. Shaw states, the needle of the seismograph was displaced by about 6½ in., or within half an inch of the amount produced by the Quetta earthquake of 1935. From the records obtained at Kew

and Bombay observatories, it appears that the epicentre lay at distances of 4,700 and 1,850 miles from these stations. Thus, the earthquake must have occurred at 1.21 p.m., G.M.T., the epicentre being in eastern Tibet in about lat. 35° N., long. 97° E., a region about 500 miles north-east of the epicentres of the great earthquakes that occurred in southern Tibet on December 15, 1934, and January 3, 1935.

Announcements

THE Gold Medal of the Royal Astronomical Society has been awarded to Dr. Harold Jeffreys for his researches into the physics of the earth and other planets and for his contributions to the study of the origin and age of the solar system.

MR. D. L. EDWARDS has been appointed director of the Norman Lockyer Observatory at Salcombe Hill, in succession to the late Dr. W. J. S. Lockyer. Mr. Edwards joined the Observatory staff soon after the Great War, when the late Sir Norman Lockyer was in charge. The new assistant is Mr. D. R. Barber, of Exeter.

THE following appointments to the Colonial Service have recently been made: R. V. Burns, to be irrigation engineer, Ceylon; W. R. W. Ferguson, to be engineer, Water Supply Section, Geological Survey, Nigeria; F. W. Roe to be field geologist, Malaya; D. F. Stewart (inspector of plants and produce, Gold Coast), to be agricultural officer, Uganda; H. D. Tonking (assistant bacteriologist, Kenya), to be senior pathologist, Mauritius.

AT the invitation of the Royal Society, the International Council of Scientific Unions will hold its triennial General Assembly at Burlington House, London, on April 27–May 4. China, through the Academica Sinica of Nanking, has recently joined the Council, which now includes forty-two countries in addition to the International Unions of Astronomy, Geodesy and Geophysics, Chemistry, Scientific Radio, Physics, Geography and the Biological Sciences.

PROF. WALTER B. CANNON, George Higginson professor of physiology in the Harvard University Medical School, has been elected a corresponding member of the National Academy of Medicine of Buenos Aires.

PROF. WILTON MARION KROGMAN, associate professor of anthropology at the School of Medicine of the Western Reserve University, Cleveland, has been awarded the one thousand dollar prize of the *Readers Digest* for his article entitled "The Skeleton Speaks", in which he gave an account of some of his medico-legal interpretations of crime.

THE German Röntgen Society has nominated as honorary members Prof. Aristide Busi, director of the Radiological Institute of the University of Rome, and Prof. Arthur C. Christie, professor of clinical radiology, Gaytown University Medical School, Washington, D.C., and as corresponding members Dr. B. K. Kirklin of the Mayo Clinic, Rochester, U.S.A., and Dr. Emil Lazeanu, president of the Rumanian Radiological Society.

DR. LAWRENCE WADE BASS has recently been appointed assistant director of the Mellon Institute of Industrial Research. Dr. Bass, who previously distinguished himself by his researches in organic chemistry and biochemistry, has been devoting special attention to industrial research management and chemical economics. He has made many important contributions to chemical literature. He and Dr. P. A. Levene of the Rockefeller Institute published in 1931 a comprehensive treatise on "Nucleic Acids" as a monograph of the American Chemical Society. Dr. Bass and Dr. Levene have also written chapters for the "Biochemisches Handlexikon", a standard German reference work.

THE Institute for Science of Labour in Japan has removed from Kurashiki to Tokyo and will be reconstructed with the aid of the Imperial Government and of the Foundation for the Promotion of Scientific and Industrial Research of Japan. The director is G. Teruoka and the new address, Institute for Science of Labour, Aoyama 5 Chome, Tokyo, Japan.

A SCHOOL of criminological science attached to the faculty of law has recently been opened at the University of Brussels.

DR. OTTO GESNER has been nominated professor and director of the Institute of Pharmacology in the University of Halle.

PROF. PIETRUSKY has resigned his office of rector of the University of Bonn and has been succeeded by his nominee, Dr. Karl Schmidt, professor of ophthalmology at Bonn.

A NUMBER of reprints of many of the scientific papers of the late Prof. T. M. Lowry are still available, and may be had on application to Dr. C. B. Allsopp, The University Chemical Laboratory, Cambridge. Postage should be enclosed with each request.

H.M. STATIONERY OFFICE has undertaken the agency for the natural history publications of the British Museum (Natural History), South Kensington, S.W.7. Many of these are scientific monographs of the greatest value to students of the various branches of nature-study represented in the Museum. The economic series are of a more popular interest. A wide range of popular postcards is also on sale. These illustrate the various animals, birds and birds' eggs, butterflies, moths, bees, wasps, beetles, plants, etc., which can be studied in detail at the Museum itself. Inquiries relating to the Museum's publications may be addressed to any of the sale offices of H.M. Stationery Office.

ERRATUM.—In the article "Chemistry of Essential Oils" in NATURE of January 9, p. 80, par. 1, line 6, for "Australia" read "eastern coast of Australia".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 117.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Maturity and Fecundity of One-Year-Old English Native Oysters, *O. edulis*

BY the courtesy of Major A. Gardner, one of us (J. H. O.) was able to study the spawning, spatfall and growth of the native oyster, *O. edulis*, on the Blackwater and Roach oyster beds in 1935 and 1936. The summer of 1935 resembled that of 1921 in being continuously warm, and also in yielding heavy falls of spat on the Blackwater. In 1922, one of a small sample of one-year old oysters obtained there experimentally was found at this extremely early age carrying larvæ[1]. The prevalent notion is that English natives do not mature until they are three years old. In a lot of 104 selected well-grown 1935 spat from the Blackwater kindly supplied by Major Gardner on August 6, 1936, two were found with young, three were mature or nearly mature females and fourteen were ripe males. New evidence was therefore obtained of the possibility of English native oysters maturing as females and producing young at an age of a little more or less than one year after an exceptionally warm season.

There is virtual certainty that all the sample were 1935 spat although obtained from the beds, as (1) the 1934 spatfall was a failure so that mixture of 1934 spat is improbable; (2) the growth of the 1935 spat has been followed closely, rendering their identification practically certain; (3) the average weight of a hundred of the dried shells is 4·83 gm. and that of the spawning and ripe females respectively 5·8, 6·2, 3·9, 5·4 and 4·6 gm.; the average length and breadth of 104 shells is 42·6 mm. by 41·4 mm. and that of the females 43 mm. by 43 mm. The females have only slightly heavier shells on the average than the selected sample (see Fig. 1).

It is not possible to discuss here all the problems arising out of early female maturity, but it may be noted that the actual percentage of mature females at this early age was small in 1936; on the River Roach only one mature female occurred among 276 of the largest obtainable in August and September.

We estimated the number of shelled and just coloured larvæ borne by one of the two individuals with young and found approximately 240,000. By the same method of estimation, the larvæ obtained from the smaller one-year old oyster in 1922 were found to number at least 84,000. Dantan[2] found in six French one-year old *O. edulis* 69,000–144,000 and an average of about 95,000. In estimating the number of larvæ it was found that haphazard stirring in a concave bottomed bell-jar was not entirely satisfactory. Concordant results were obtained by using an almost flat-bottomed wide cylindrical glass jar (15 cm. in diameter) and a special stirrer of perforated zinc in the form of a cross with a hole in the centre, and at the opposite ends of one arm upturned limbs to allow the stirrer to be moved up and down while samples were actually being taken.

Successive samples taken in this way with a 2·5 c.c. Stempel pipette from 2,000 c.c. of suspension liquid containing the 1936 batch of young yielded 298 and 295 larvæ at the surface, 274, 277 and 287 in mid-water and 305, 313, 328 and 311 at the bottom; the last figure in each group referring to side samples and the others to central samples. 5,000 larvæ had previously been taken from the sample. As a check on the method, these 5,000 larvæ were transferred to 1,000 c.c. of 5 per cent formalin, and 2·5 c.c. samples taken as before with the Stempel pipette after and during stirring. The numbers obtained were respectively 13, 13, 11, 13 central surface,

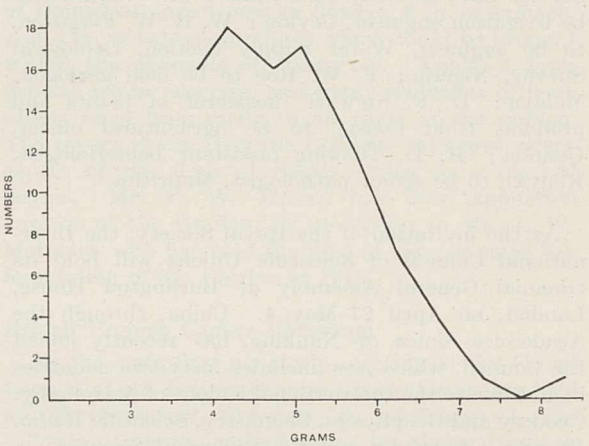

Fig. 1.

OPTIMAL GROWTH IN NATURAL ONE-YEAR OLD ENGLISH NATIVE OYSTERS, *O. edulis*; R. BLACKWATER, JULY 1936–AUGUST 1936; 92 SELECTED LARGEST SHELLS. (MEAN DRY SHELL-WEIGHT IN HALF-GRAM GROUPS IS GIVEN AFTER DRYING AT ABOUT 80° C. FOR ONE HOUR.)

22, 12, 14, 10 middle middle, and 15, 11, 14 central bottom. With uniform distribution 12 or 13 larvæ would be taken in such samples. In all these samplings with the exception of one, the 22 in the last lot, the variation from the mean is less than the square root of the mean. The mean gives therefore a good approximation; and the method of sampling is satisfactory. It is interesting that the high figure 22 was the first sample taken from the known number of 5,000 after a long period of settlement, indicating interlocking or inefficient mixing, and that it is advisable to omit sampling after the first mixing to ensure even distribution.

The volume of the larvæ after one and three days settlement was found to be approximately 0·575 c.c.,

giving about 417,000 per c.c. after considerable shrinkage in 5 per cent formalin during four months. This result is considered not incompatible with an independent count of 11,928 larvæ (preserved in the slightly smaller trochosphere stage) in one drop of liquid, giving about 300,000 per c.c. without close packing.

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J. MCCLOY.
H. C. DAVIES.
F. B. J. EDMONDS.
J. H. ORTON.

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University, Liverpool.
Dec. 21.

[1] Orton, J. H., NATURE, **110**, 212 (1922).
[2] Dantan, J.-L., *C. R. Acad. Sci.*, **157**, 871 (1913).

Interchange of Hydrogen Isotopes in Complex Cobaltammines

ERLENMEYER and Gartner[1] have reported that interchange of hydrogen isotopes takes place when hexammine cobaltic nitrate, $[Co(NH_3)_6]$ $(NO_3)_3$, is dissolved in heavy water, all the hydrogen atoms being replaceable. Bankowski[2], however, has stated that the hydrogen in complex ammines is only partially replaceable, one atom being interchanged in $[Co(NH_3)_4(H_2O)_2]Cl_3$, and three atoms in $[Co(NH_3)_4CO_3]Cl$.

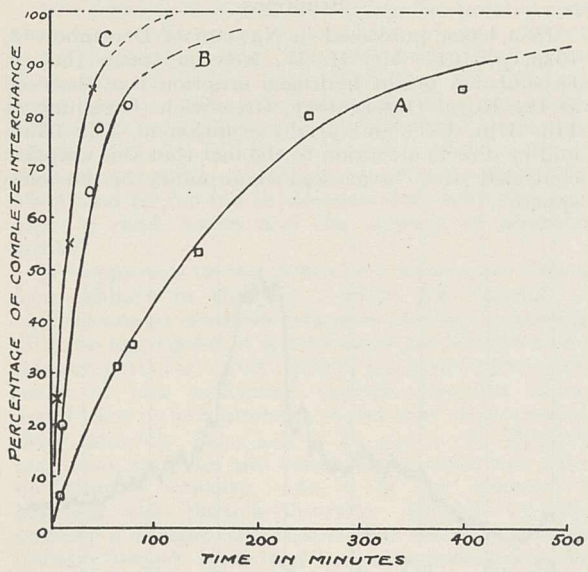

Fig. 1.

We have re-examined the question of isotope interchange with complex ammines in solution, with special reference to 1,6 dinitro tetrammine cobaltic nitrate, carbonato tetrammine cobaltic nitrate, hexammine cobaltic chloride and triethylene diamine cobaltic chloride. In agreement with Erlenmeyer's results, we find that all the amine hydrogen contained in the complex may be interchanged with deuterium; we also find, however, that at 25° and 35° the interchange proceeds quite slowly, the time of half change being several hours; and Bankowski's inherently improbable conclusion may be due to his failure to observe this fact.

In our experiments, which have been most fully worked out for hexammine cobaltic chloride, the salt was dissolved in approximately 3 per cent heavy water, and at suitable intervals a portion of the solution was removed and the extent of interchange was ascertained by separating the water therefrom and observing its density relative to that of the original heavy water by a micro-flotation method, giving relative densities within $\pm$ 0·5 γd on a sample of 0·25 c.c., which will be described elsewhere. The first experiments were made by distilling off the water from the samples *in vacuo* as rapidly as possible (Fig. 1, *A* and *B*). Afterwards, it was found to be preferable to add the samples to excess of dry, powdered, mercuric chloride, thus precipitating the complex cation as the mercurichloride, $[Co(NH_3)_6]Cl_3.HgCl_2$, and arresting the interchange quite sharply. After filtration, the water was purified by distillation and its density was determined as before (Fig. 1, *C*).

As may be seen from Fig. 1, complete interchange requires a considerable time, and the interchanges at shorter times lie on curves asymptotic to the line representing complete interchange.

By a further modification of the experimental method, it has been possible to make a full kinetic analysis of the reaction mechanism, and the results of this further work, which appear to be of considerable significance in relation to the theory of the co-ordination complex, will shortly be published in full.

F. W. JAMES.
J. S. ANDERSON.
H. V. A. BRISCOE.

Imperial College of Science,
London, S.W.7

[1] Erlenmeyer and Gartner, *Helv. chim. Acta*, **17**, 1008 (1934).
[2] Bankowski, *Monats.*, **65**, 266 (1935); cf. Erlenmeyer and Lobeck, *Helv. chim. Acta*, **18**, 1213 (1935).

The Fifth Skull of Peking Man

A RECENT letter via the trans-Siberian mail brings the information that the fifth skull of Peking man, lately discovered, is the most complete specimen ever found at Choukoutien, near Peking.

It was discovered by Mr. L. P. Chia on November 26, 1936, in the same layer of the fossiliferous deposit as the other two skulls collected ten days before (see NATURE, Dec. 12, 1936, p. 1004, and Dec. 19, 1936, p. 1056), but about six metres farther south.

Except for the teeth, which are missing, this specimen is exceptionally well preserved and complete; the nasal bones and the left orbit are undamaged, and connected with the back parts, including the foramen magnum and other delicate bones, which are in very good condition. The middle vault of the skull has not been badly crushed in the brecciated matrix, which has made it possible for Prof. F. Weidenreich to remount it within a week of its transport from the field to the laboratory.

This skull (male type) does not belong to a fully adult individual, but to one who is evidently older than that represented by the No. 1 skull. The orbital ridges are more strongly developed than, but the general architecture remains the same as, the skull No. 1, described by the late Prof. Davidson Black.

Prof. Weidenreich is now preparing a short note which will appear in the near future, and will present his preliminary observations, with diagrams, on the last three skulls. Before the appearance of his official

statement, I hope that scientific workers will withhold their judgment on the latest discoveries of *Sinanthropus*, and ignore the inaccurate rumours already circulated that the last three skulls of *Sinanthropus* are identical with the *Pithecanthropus* or *Homo neanderthalensis* skulls.

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Paris. XIII.
Dec. 29.

A Simple Means of Checking the Michelson-Morley Experiment

THE epoch-making work of Prof. Dayton C. Miller, as reported two years ago in NATURE[1], has established that the small effect found by Michelson and Morley is a reality. In a paper read by me before the American Physical Society which has as yet only appeared in abstract form[2], it is shown that there is a v^2/c^2 effect in both arms of the interferometer (also shown by Voigt[3] in 1887). If, however, the ray of light is not perfectly normal to the end mirror, the ray is displaced during the motion and this displacement gives rise to a small effect (about one four-thousandth of v^2/c^2 in Miller's case—due to the ray having an angle of obliquity of about 1′). I find on applying my formula to his results, a value for the cosmic motion of 300 km./sec., while his method of computing the effect gives 200 km./sec. The discrepancy between these results was traced to his floating apparatus being unbalanced, causing the interferometer to be *very slightly* out of level. Secondary effects due to this slight unbalance may be seen in his results, as well as the effect due to the obliquity of the ray, and it has been found, by inclining one arm of the interferometer while the other remains level, that a very large displacement of the fringes may be produced, since it is the *component* of the cosmic velocity in each arm which affects the ray in that arm.

As shown by Miller, the cosmic velocity is nearly vertical at some time during the day, and at some other time nearly horizontal. Therefore twice a day the cosmic velocity makes an angle of 45° with the normal to the plane of the horizon, and by inclining one arm of the interferometer at 45° while the other arm remains level, rotation about a vertical axis will bring the 45° arm into the line of direction of the cosmic motion, and we shall have in this arm not merely a component of this velocity, but the full value of 300 km./sec. When rotated 180° from this position, the 45° arm will be at right angles to the cosmic motion and the component will have a zero value, and we therefore have a full shift of the fringes between two points 180° apart. In the level arm there will be no change because, as shown by Voigt, while the motion of the source gives us a v/c effect and a v^2/c^2 effect, the v/c effect is annulled by the motion of the observer, the v^2/c^2 effect remains and is independent of the orientation of the interferometer, the wave surfaces being spherical. (See page 50 of Voigt's Doppler effect paper[4].)

It would be rather difficult to incline a large interferometer like Miller's at 45°, but it can easily be done with a small one. A simple turntable may be used which may be tested for suitability by placing a level interferometer upon it, and noticing whether there is any appreciable fringe shift on rotation; if not it may be assumed that the turntable is satisfactory. A good carpenter can make a framework in two or three hours that will support the interferometer solidly and stably at the proper angle. Send the ray of light from the source along the horizontal arm, and the fringes from the 45° arm may be seen by means of an auxiliary plane mirror suitably mounted (an ordinary mirror will do), and after having properly adjusted the interferometer, a short focus horizontal telescope may be used to view the fringes reflected from the auxiliary mirror.

Preliminary measurements with an interferometer having equal arms 6¼ in. long gave a shift of approximately six tenths of a fringe, in agreement with the following calculations.

$$\delta F = \frac{2l}{\lambda}\cdot\frac{v^2}{c^2} = \frac{31{\cdot}75}{5{\cdot}461\times10^{-5}}\cdot\frac{9\times10^4}{9\times10^{10}} = 0{\cdot}581.$$

Contrary to expectation, the magnitude of the fringe shift seems to be practically the same at any time of day.

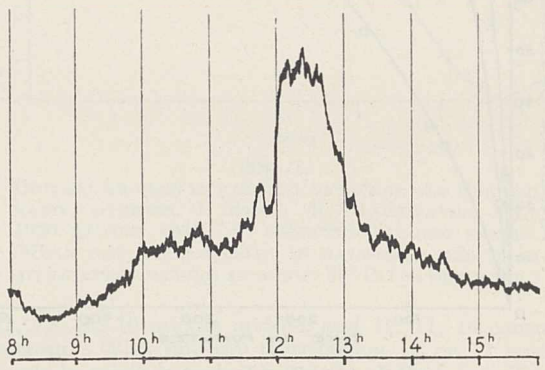
W. B. CARTMEL.

Laboratoire de Physique,
Université de Montréal.
Dec. 7.

[1] Miller, Dayton C., NATURE, **133**, 162 (1934).
[2] Cartmel, W. B., *Phys. Rev.*, **2**, 49, 647, 649 (1936).
[3] Voigt, W., *Goettinger Nach.*, 1–21, 233 (1887).
[4] Voigt, W., *Goettinger Nach.*, 1–21, 41 (1887).

Abnormalities of the Ionosphere and Bright Solar Eruptions

IN a letter published in NATURE of December 12, 1936, p. 1017, Mr. H. W. Newton states that in December a bright hydrogen eruption was observed at the Royal Observatory, Greenwich (beginning at 11h. 57m. U.T. and bright eruption at 12h. 03m.) and he directs attention to the fact that this eruption coincided with "a marked abnormality in the ionosphere".



St. Cyr, 27 kc./s. December 3, 1936.

Fig. 1.

On the same day and at the same time, I pointed out in Paris (St. Cyr) a large increase in the number of atmospherics on 27 kc./s. (11,500 m.). Fig. 1 is from a photograph of the interesting part of the St. Cyr record. African records (Tunis and Rabat) show the same phenomenon at the same time, but less intense. These sudden rises in the number of atmospherics are not new phenomena. I have already reported such increases, some even more sudden, and I have pointed out that they depend on modifications of the ionosphere[1].

The increase of the number of atmospherics received does not correspond with the number of atmospherics produced but with an improvement in the propagation of the long waves over a great distance.

The same ionospheric phenomenon is obvious as an opposite effect in the short-wave spectrum. M. Jouaust, secretary of the Comité Français de Radiotélégraphie scientifique, was the first to emphasize the interest[2] of the study of sudden fading in short-wave commercial traffic; they have since been observed on different continents. They coincide with the increase of atmospherics on long waves[3].

The study of atmospherics has now acquired a new interest. It seems certain that some peculiarities of these records are closely associated, in time, with ionospheric perturbations, which, at least in part, are the direct consequence of solar eruptions.

R. BUREAU.

Office National Météorologique,
Paris, 7e.
Jan. 4.

[1] Bureau, R., "Electricité atmosphérique et parasites atmosphériques". Communication faite à l'Association Internationale de Magnétisme et Electricité terrestres, Assemblée d'Edimbourg Septembre 1936. Document n°44.

[2] "Rapport sur certains phénomènes d'évanouissements", 1935.

[3] Bureau, R., and Maire, J., "Anomalies Ionospheriques à début brusque", *C.R. Acad. Sci.*, **203**, 1276 (1936).

Equivalent Particle-Observers

IN a letter to NATURE, Prof. Synge has pointed out[1] that the condition of equivalence of two distant particle-observers does not completely define the time-scale of either, and that *any* two distant particle-observers may be provided with clocks which satisfy the condition of equivalence and make the relative velocity of the two equal to zero. Synge concludes that the relativistic theories developed by Milne and by me fail to dispense with both the concept of rigid bodies and the concept of absolute clocks.

My approach to the relativistic kinematics differs from Milne's in that he employs the concept of equivalence to establish reference systems consisting of dense aggregates of synchronous particle-observers relatively at rest. Now Synge's analysis of the time-scales of two equivalent particle-observers whose world-lines do not intersect shows that all successive time intervals $F_{n+2,\,n+3} - F_{n,\,n+1} = 2k$ (Synge's notation) must be the same if the observers have no relative velocity. As k is the distance r between the particle-observers divided by the velocity c of light, this means that the time-scale of either observer is divided uniquely into successive intervals of magnitude $2r/c$, but that the subdivision of any one of these intervals into smaller intervals is arbitrary. As the distance r between the two observers is made smaller, however, the smallest interval $2r/c$ uniquely determined becomes proportionately smaller. Hence, even the smallest time intervals on the clocks of a dense assemblage of synchronous particle-observers constituting a reference system are completely determined.

Now consider two particle-observers P' and P'' whose world-lines cross, but neither of which intersects the world-line of P. As Synge indicates, with one pair of clocks we can make P and P' synchronous and relatively at rest, whereas with another pair we can make P and P'' synchronous and relatively at rest. Therefore we can associate with a single particle-observer P more than one *linear* reference system. This arbitrariness, however, disappears in the three-dimensional case, where we impose a geometry on a reference system. For the papers of Engstrom and Zorn[2] and of Robertson[3] show that we can associate at most a single Euclidean reference system with P. Hence it would seem that we are able to dispense with both the concept of the rigid measuring rod and that of the isochronous clock in this case, or, to put the matter the other way around, we have established an ideal criterion by which to test both the rigidity of material rods and the isochronism of material clocks.

The statement in my paper[4] which Synge criticizes should be taken to refer to the *relative* readings of the clocks of P and P'.

LEIGH PAGE.

Yale University.
Dec. 4.

[1] Synge, J. L., NATURE, **138**, 28 (1936).
[2] Engstrom and Zorn, *Phys. Rev.*, **49**, 701 (1936).
[3] Robertson, H. P., *Phys. Rev.*, **49**, 755 (1936).
[4] Page, Leigh, *Phys. Rev.*, **49**, 254 (1936).

Microscopic Examination of Fog-, Cloud- and Rain-Droplets

OF the many methods proposed hitherto for the measurement of the size and concentration of droplets in fogs and clouds, none can be considered as quite satisfactory. The extensively used method of diffraction rings (corona) can be applied only in the relatively rare case of isodisperse fogs. The photographic method devised by Findeisen[1] is rather complicated, and can scarcely be used in field work. The direct measurement of the droplets collected on greased wires or on glass slides is hampered by very rapid evaporation of the droplets and distortion of their spherical shape. The method proposed recently by Hagemann[2], namely, collecting the droplets on a thin layer of castor oil and photographing them during their fall through the layer, has many disadvantages and can be used only for droplets with a radius less than 5 μ.

After having tried unsuccessfully many different methods, we discovered that quite satisfactory results can be obtained by collecting the droplets on glass slides coated with a freshly melted mixture of vaseline and light mineral oil. The proportion of the ingredients depends on the temperature of the air (about 1 : 3 at 20° C., 1 : 5 at 0° C., and so on).

This mixture has the property of instantly enveloping the water droplets as they settle with a thin film, which practically prevents both evaporation of the droplets and condensation of vapour on them, without affecting their spherical shape. The droplets thus collected on the slides can be preserved in a damp atmosphere for many hours without showing any perceptible diminution in size. The only condition which has to be observed is that the temperature at which the droplets are kept and measured is equal to or below that at which they were collected or, at any rate, does not exceed it by more than a few degrees. The smallest droplets, distinguishable only with a microscope objective of the highest resolving power, can be examined in this way, as well as rain-droplets of 2–3 mm. diameter. The thickness of the vaseline layer must, however, be greater than the diameter of the droplets.

Fig. 1 (left hand) shows a photomicrograph (magnification 1 : 50) of droplets collected during a 10-minute exposure of glass slides in a dense fog, which occurred in Moscow on the night of November 2 (air temperature, 5° C.). The size of the droplets lay within the limits of about 0·006–0·030 mm. radius. In order to determine the real distribution of the sizes of droplets, the glass slides would have to be put at the bottom of a chamber filled with the fog. All the droplets contained in the chamber should then be allowed to settle on the bottom. This could not be done, as fogs are very rare in Moscow and this one happened quite unexpectedly. Fig. 1 (right hand) shows a photomicrograph taken of rain droplets (magnification 1 : 10).

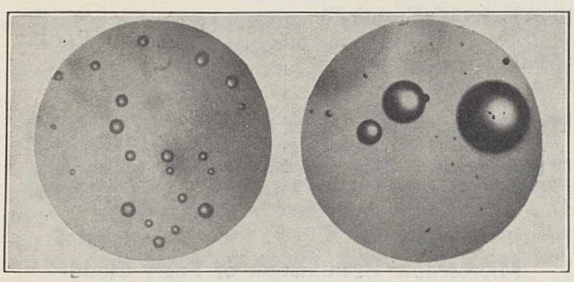


Fig. 1.
FOG PARTICLES (LEFT), × 50; AND RAIN DROPLETS (RIGHT), × 10

All the apparatus needed for the visual or photomicrographic measurements of droplets (an electric battery for illumination included) weighs about 12 lb. and the method can be readily used in the field, during balloon flights, etc. Measurements made from a balloon continuously kept in equilibrium with the surrounding air would give invaluable information about the kinetics of the formation and precipitation of clouds—processes about which very little is as yet known.

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I. PETRJANOFF.

Laboratory of Aerosols,
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Moscow.

[1] Findeisen, *Gerlands Beiträge*, **35**, 295 (1932).
[2] Hagemann, *Gerlands Beiträge*, **46**, 261 (1936).

Preparation of a Highly Active Alcohol Apo-dehydrogenase from Yeast

IT is generally recognized that an active dehydrogenase system consists of three principal components: (1) an apo-dehydrogenase, the non-dializable and thermo-labile colloidal carrier, protein in nature; (2) a co-enzyme, crystalloidal and comparatively thermostable; and (3) a flavo-protein, capable of reversible oxidations and reductions. Euler and others have advanced the view that the specificity of dehydrogenases is intimately associated with the specific protein or proteins constituting the apo-dehydrogenase, the isolation of which in a state of integral purity and high activity is necessary for an elucidation of the groups responsible for the enzymic activity. With this end in view, we have commenced a study of the isolation and purification of the alcohol apo-dehydrogenase from bottom yeast.

Dried yeast (one part), macerated with toluenated water (3 parts) at 30° C. for three hours, yields an extract which contains about 70–75 per cent of the apo-dehydrogenase, and this extract has been used as the starting material for the isolation and purification of the active protein. The activity or the concentration of the apo-dehydrogenase is expressed as seconds per milligram of protein nitrogen, required to decolourize 0·2 c.c. of a standard solution of methylene blue (1 in 5,000), in presence of an excess of the other components of the dehydrogenase system, the substrate, the cozymase and the flavo-protein. Measured on this standard, the crude extract has an activity which corresponds to 808 seconds per milligram of protein nitrogen.

The maceration extract, when treated with ammonium sulphate to full saturation, yields a precipitate centrifugible with difficulty which, however, easily dissolves in water giving a clear yellow solution.

When this solution is progressively saturated with ammonium sulphate, two distinct precipitates are obtained, one at half saturation and the other at full saturation. These precipitates, *A* and *B*, have activities respectively corresponding to 46 and 81 seconds per milligram of protein nitrogen, showing thereby that a purer preparation of the apo-dehydrogenase is obtained at half saturation. Preparation *B*, however, has been found to be comparatively free from the flavo-protein, as measured by its high response to the addition of the flavine enzyme.

Further purification of the preparation *A* is accomplished by re-dissolving the wet precipitate in water and carrying out an adsorption with zirconium hydroxide at *p*H 5. The active protein can be eluted from the adsorbate by Sørensen's *M*/15 phosphate buffer, *p*H 6·8, and a further purification can be effected by repeating the adsorption and elution under the same conditions. By adopting this procedure, it has been possible to obtain a preparation possessing an activity of 6 seconds per milligram of protein nitrogen and representing a 135-fold purification.

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Dec. 21.

Experimental Induction of Ovulation with Progesterone

THE injection of pregnancy urine extract or of anterior pituitary extract causes ovulation in *Xenopus lævis*, the South African clawed frog. Ovulation is accompanied by swelling and hyperæmia of the anal labia. In an attempt to analyse the hormonal control of the labial reaction, œstradiol (Progynon B oleosum forte) and progesterone (Proluton) were injected separately and together into a number of female frogs. Injection of both hormones together elicited the full labial reaction and in addition induced ovulation. Ovulation occurred on injection of progesterone alone but not with œstradiol alone. Progesterone also caused ovulation in hypophysectomized animals. Ovulation had previously been obtained only with pregnancy urine and anterior pituitary extracts. The results of this preliminary investigation were communicated to the Royal Society of South Africa in October, 1936. The following is an account of a more extensive investigation undertaken since then.

Large numbers of frogs were hypophysectomized. In some the whole pituitary (anterior and posterior lobes) was removed, in others the anterior lobe alone

was removed. Ten days after the operation, progesterone in doses of 0·1 mgm. and 1·0 mgm. was injected into normal animals and into the two types of hypophysectomized animals. Twenty hours after injection, readings were taken (*a*) of the percentage positive response and (*b*) of the extent of ovulation in positive animals. The latter was placed on a quantitative basis by assigning arbitrary symbols to the degree of ovulation : 1 or 2 according to the number of eggs in the oviduct ; 3 or 4 according to the number in the pars uteri ; and 5 or 6 according to the number of eggs extruded from the cloaca into the water in the container. The total score of all positive animals divided by the number of positive animals gives a figure which has been called the ovulation index. When less than 10 per cent of animals ovulate, not much significance can be attached to the index. The maximum ovulation index is 6.

Immature normal animals (15–20 gm.) were also injected with progesterone. The average weight of the mature animals was 39 gm.

Type of animal	0·1 mgm. Progesterone		1·0 mgm. Progesterone	
	Percentage response	Ovulation index	Percentage response	Ovulation index
Normal	35	2·3	100	4·5
Anterior lobe removed	16	1·2	67	2·8
Both lobes removed	6·5	(1·5)	30	3·1
Immature normal	9·5	(2·0)	43	3·0

The results show that ovulation occurs in the absence of the pituitary, but that both the anterior and posterior lobes must be present before the maximum percentage of positive response can be obtained. On the other hand, an increase in the extent of ovulation is dependent upon some factor in the anterior lobe alone. Immature animals give a higher percentage response than completely hypophysectomized frogs but the same ovulation index.

Normal and completely hypophysectomized animals were injected with pregnancy urine extract. The dose chosen was that which just gave 100 per cent response when injected into normal animals. The hypophysectomized frogs gave 100 per cent response and an ovulation index of 5·5. The index in normal frogs was 5·0.

There was no significant difference in percentage response and ovulation index between completely hypophysectomized animals injected with progesterone alone and the same type of animal injected with progesterone and Parke, Davis pituitrin.

The ovulating effect of progesterone is strikingly demonstrated by its action on the excised ovaries of normal and hypophysectomized animals. The ovary is excised and placed in a glass dish containing Ringer's solution. The addition of 1 mgm. progesterone causes extrusion of numerous ova within 8–10 hours at a temperature of 21° C.

Coupling, ovulation and fertilization of eggs were induced by injecting males with anterior pituitary extract and females with progesterone. Ovulation and oviposition occur after injection of so small a dose as 0·05 mgm. progesterone.

Since the completion of these experiments, Shapiro[1], at the National Institute for Medical Research, Hampstead, has confirmed the findings for progesterone induced ovulation in *Xenopus* and has obtained the same result with the following steroids : methyltestosterone, testosterone, *allo*-pregnanedione, androstenedione, *trans*-dehydroandrosterone, *cis*-androstanediol, androsterone, Reichstein's adrenal substance J, "Eucortone" adrenal cortical extract.

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Dec. 9.

[1] Shapiro, H. A., *Chem. and Ind.*, **55**, 1031 (1936).

Segmental Interchange Lines in *Pisum sativum*

IN collaboration with Miss Pellew, crosses between a number of lines of spontaneous or natural origin, showing interchange of segments between non-homologous chromosomes in *Pisum sativum*, have been studied at the John Innes Horticultural Institution, Merton, and at the Botanical Department, University of Manchester.

As a result of the analysis of the chromosome associations at meiosis in these crosses (seven pairs or an association of four—not a ring—results when the same two chromosomes are concerned in the two interchanges, an association of six when one chromosome is common to both interchanges, and two rings of four when entirely different chromosomes are affected), seven types differing in chromosome structure and therefore called 'structural types' have been distinguished, and their interrelationships determined. The chromosomes taking part in these interchanges are as follows, where arbitrary numbers are given to the seven haploid chromosomes of the normal or standard type :

Structural type 1. The normal or standard type.
Chromosomes 1, 2, 3, 4, 5, 6, 7.
Structural type 2. Hammarlund's *K*-line.
Chromosomes 1 and 2 interchanged.
Structural type 3. The Thibet interchanged line.
Chromosomes 1 and 3 interchanged.
Structural type 4. Extra rapid.
Chromosomes 3 and 5 interchanged.
Structural type 5. An interchanged type from Miss de Winton's material.
Chromosomes 4 and 5 interchanged.
Structural type 6. Wing's line.
Chromosomes 1 and 4 interchanged.
Structural type 7. The doubly-interchanged type from structural type 2 × structural type 3.
Chromosome 1 interchanged with 2 and 3.

Structural type 7 when crossed with structural type 6 gives, as expected, an association of eight chromosomes at meiosis, the highest association yet reported in *Pisum*.

Nilsson[1] studied the relationships between structural type 4 and three other types which cannot be classified in relation to those recorded in the present communication until the necessary tests have been made.

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Dec. 16.

[1] Nilsson, E., *Hereditas*, **21** (1935–36).

Linkage in Structural Hybrids in *Pisum sativum*

THE genetical analysis of some of the interchanged lines in *Pisum sativum*, reported on by Mrs. Sansome above, has given evidence on the distribution of the genes in the normal structural type. In plants of normal structure the genes *R* (*R*/*r* = round/wrinkled cotyledons) and *A* (*A*/*a* = coloured/white flowers) have been

exhaustively studied in F_2 families from self-fertilization. By this method no clear indication of linkage was found. From back-crosses (453 plants from heterozygous females, and 418 plants from heterozygous males) 47 per cent of crossing-over was obtained[1]. Hence, in a recent summary of our knowledge of linkage in *Pisum*, these two genes are placed in different chromosomes[2].

Chromosome 1 of the normal structural type has undergone interchange with three other chromosomes in types 2, 3 and 6. When these three types are crossed with the normal, and the F_1 structural hybrids are also heterozygous for *R* and *A*, the F_2 progenies show either linkage between *R* and *A*, with about 30 per cent crossing-over (in hybrids 1 × 2 and 1 × 6), or linkage of both genes with the gametic sterility by which the position of the translocation is indicated (in hybrid 1 × 3). The evidence is derived, in hybrid 1 × 2, from back-cross ratios, and in hybrids 1 × 3 and 1 × 6[3] from F_2 ratios. Hence it follows that the genes *R* and *A* lie in the one chromosome of the normal type common to all three associations of chromosomes in the hybrids at meiosis, that is, in No. 1 of Mrs. Sansome's list.

That linkage may be shown in structural hybrids but not in homozygous types may be expected from the slight reduction in chiasma frequency observed by Sansome[4] and Sutton[5] and characteristic of such hybrids. Further, the incidence of gametic sterility in relation to other genes serves as a new locus. Hence the genetical analysis of structural hybrids may be a more effective method of studying the distribution of the genes than the analysis of structurally homozygous types.

CAROLINE PELLEW.

John Innes Horticultural Institution,
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Dec. 11.

[1] Pellew, C., *Z. Zucht. A, Pflanzenzücht.*, **17**, 90 (1931).
[2] Winge, Ö., *C.R. Trav. Lab. Carlsb.*, (Ser. Physiol., 15), **21** (1936).
[3] Sansome, F. W., and E. R., unpublished.
[4] Sansome, E. R., *Cytologia*, **3**, 200 (1932).
[5] Sutton, E., *Ann. Bot.*, **49**, 689 (1935).

Technique of the Painting Process in the Cave Temple at Sittannavasal

As an extension of my studies[1] on Indian paintings, I have had recently an opportunity of investigating the technique of the painting process adopted in the cave temple at Sittannavasal in the Pudukottah State, South India, situated at a distance of about 42 miles by road from Tanjore. This cave temple is very small, being about 24 feet long, 12 feet wide and 11 feet high. The interior was at one time fully painted, but at present the paintings are visible only on the ceilings, the capitals and the upper parts of the pillars. These paintings, which can be assigned to the time of the great Pallava king, Mahendravarman I (*c.* 600–625 A.D.)[2], represent the best specimens of Jain mural paintings of the classical or Ajanta school extant in India, and there can be no doubt about their æsthetic merit or high importance from the point of view of history.

From a study of the painted stucco, it is clear that the technique adopted in the execution of these paintings is one of *fresco-secco* or painting in lime medium on plaster. The stucco is composed of the *Rinzaffo* or rough coat of lime plaster with a fine lime wash thereon. The lime wash was probably given while the plaster was still wet. The thickness of the stucco depends on the nature of the surface of the wall and the ceilings, and varies from 1·9 mm. to 3·4 mm. and in certain places it goes up to about 8·9 mm.

The results of analysis of the stucco (excluding the lime-wash) were as follows :

	Per cent
Moisture	2·14
Silica, SiO_2	48·91
Iron and alumina, $Fe_2O_3 + Al_2O_3$	3·98
Carbon Dioxide, CO_2	18·07
Lime, CaO	24·37
Magnesia, MgO	0·35
Sulphuric anhydride, SO_3	0·11
Loss on ignition	0·65
Undetermined (mostly alkalis)	1·39
	99·97

The only inert material used with the lime is sand.

So far as pigments are concerned, lime has been used for the white, carbon for black, yellow and red ochres for yellow and red, lapis lazuli or ultramarine for blue, terre verte for green and a mixture of the last two for bluish-green.

Full details of the investigation will be published in the Technical Studies of the Fogg Art Museum of Harvard University.

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Dec. 19.

[1] NATURE, **137**, 867 (1936).
[2] Mehta, N. C., "Studies in Indian Painting" (Taraporevala, Bombay, 1926, p. 9).

Raman Spectrum of Benzene Vapour

MUCH interest is attached to the structure of benzene, and a series of important papers[1] dealing with this subject and based mainly on Raman, infra-red and emission spectra have recently appeared from University College, London. In this connexion it is very desirable to possess a knowledge of the Raman spectrum of benzene vapour, but no data are yet

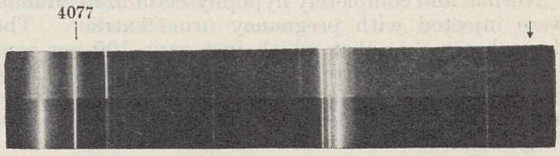

Fig. 1.
RAMAN SPECTRUM OF BENZENE VAPOUR (ABOVE), LIQUID (BELOW).

available. Fig. 1 (upper spectrum) shows the Raman spectrum of benzene vapour obtained by us at a pressure of 15 atm. and a temperature of 200° C.; the lower spectrum is the Raman spectrum of the liquid taken alongside, keeping the conditions regarding slit width, etc., unaltered but reducing the time of exposure. Fig. 2, *a* and *b*, are photometric records of the wings accompanying the λ 4077 and λ 4046 lines respectively in the vapour. Fig. 2, *c*, is the record of the wing accompanying the line λ 4046 in the liquid taken under identical conditions. Among other notable features, the following changes which take place as we pass from the liquid to the vapour are of special significance.

The principal Raman line 992 shows no shift. 3061 shows a definite shift (see arrow in Fig. 1) and has a value of 3069 in the vapour. 3047 has either completely disappeared or has been considerably

weakened. The rotation wings accompanying the Rayleigh lines, which show no intensity maximum separated from the centre (Fig. 2, *c*) in the liquid, develop a distinct maximum at the expected position (Fig. 2, *a* and *b*) in the vapour. The absolute intensity of the rotation wing, as judged by comparing it with the 992 Raman line, increases enormously as we pass into the vapour state. For example, the wing accompanying the 4077 line has not been recorded at all in the liquid whereas it is quite intense in the gas (see Fig. 1), in spite of the fact that the 992 Raman line is recorded with greater intensity in the former than in the latter.

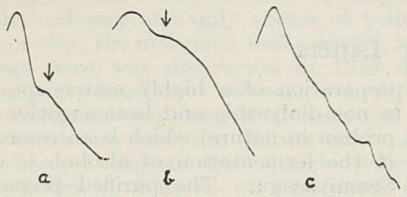

Fig. 2.

The significance of these and other features of the investigation will be discussed by us in detail elsewhere.

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Nov. 16.

[1] C. K. Ingold and others, *J. Chem. Soc.*, 912–987 (July 1936).

Active Nitrogen

IN their recent paper on the afterglow in active nitrogen, Cario and Stille[1] have doubted the reality of the production in the nitrogen afterglow of the N_2^+ first-negative bands and those bands of the N_2 first-positive system which originate on vibrational levels higher than $v' = 14$. It is suggested that my results were due to an accidental superposition of light from the exciting discharge on that of the afterglow.

An examination of the afterglow photographs published by Cario and Stille shows immediately the reasons for their failure to observe the above mentioned bands in the afterglow. Their nitrogen was not purified enough for the tube to reach what I have called the auroral stage. Their photographs show the bands due to nitric oxide and cyanogen in the spectrum of the afterglow, whereas these bands, as an examination of my published spectra will show, should have completely disappeared before the auroral stage is reached.

During the preparation of more than a score of tubes, I have passed through the stage photographed by Cario and Stille. There are, at the present time, two tubes in my laboratory which show the stage they have photographed, and several much purer tubes. In several of the latter type of tubes the negative bands are so strong that they can be observed visually on a direct vision spectroscope. In none of those tubes can we observe the nitric oxide or cyanogen bands. These have disappeared because of the purification of the nitrogen.

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[1] Cario and Stille, *Z. Phys.*, **102**, 317 (1936).

Reflection from the Ionosphere

THE conditions for the reflection of radio waves from the ionosphere are generally obtained by putting $\mu^2 \doteqdot 0$. But it is more correct, as was pointed out by Appleton[1], to obtain this condition by finding out when the group velocity vanishes. If we work out the conditions for the vanishing of the group velocity, neglecting friction, we find certain unexpected results. While for the ordinary wave there is only one condition of reflection given by

$$p = p_0 \quad . \quad . \quad . \quad . \quad (1)$$

(where p is pulsatance and $p_0^2 = 4\pi Ne^2/m$), the conditions for the extraordinary wave are found to be as follow:

$$p^2 - pp_H = p_0^2 \quad . \quad . \quad (2a),$$
$$p^2 + pp_H = p_0^2 \quad . \quad . \quad (2b),$$
$$p^2 - p_T^2 = p_0^2 \text{ (app.)} \quad . \quad (2c),$$

where $p_H = eH/mc$, $p_T = eH_T/mc$, when we are using short waves. The first and second of these are those usually obtained for the extraordinary wave reflection. It is usually supposed that (2*a*) is the only one obtained, as (2*b*) is supposed to penetrate and to be absorbed. Toshniwal[2] was the first to observe and interpret the reflection corresponding to (2*b*). This has also been recently confirmed by Leiv Harang[3] working at Tromsø. The third is a new one and has not been so far reported.

It is well known that for the reflection corresponding to (2*a*), the difference between the penetration frequencies for the ordinary and the extraordinary waves is approximately 0·7 mc./sec. While this has been confirmed in this laboratory, Messrs. Pant and Bajpai, working after midnight, have several times observed the penetration frequency difference to be only about 0·14 mc./sec. This result at first appeared to be very puzzling, as it could not be accounted for on the existing theories. But it is easily explained as a reflection given by (2*c*). At Allahabad, $p_T^2 = 40{\cdot}5 \times 10^{12}$, and in the neighbourhood of 75 metres the difference between the penetration frequencies is 0·13 mc./sec. according to (2*c*). For higher latitudes (for example, England) this difference will be very small (for 4 megacycles, 0·03 mc./sec.) and it will be difficult to observe. It would be interesting to know whether similar results are obtained at other tropical stations.

Details of the calculation are being published in the proceedings of the National Institute of Sciences, India.

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Dec. 21.

[1] Appleton, NATURE, **122**, 879 (1928).
[2] Toshniwal, NATURE, **135**, 437 (1935).
[3] Leiv Harang, *Terr. Mag.*, June 1936.

Who were the Picts?

IN the note in NATURE of December 19 (p. 1061) upon Dr. Bachmakoff's discussion about the evidence of a pre-Aryan population of southern Russia, he is quoted as suggesting that in France the Veneti were a pre-Aryan people "possibly related to the Picts". This lands one in the vexed question whether there ever was a race or tribe that assumed and bore the name Pict.

The earliest occurrence of that name in literature is in the chronicle by Ammianus Marcellinus (A.D. 326–391) describing under the year 364 how the Roman province in North Britain was continually raided by "Picti Saxonesque et Scoti et Attecotti". The "Pictish Chronicle", composed in the fourteenth century, begins with a quotation from the "Origenes" of Isidore, Bishop of Seville (560–636), as follows :

"Picti propria lingua nomen habent a picto corpore" ; but it is to be noted that Bishop Isidore wrote "Scoti" not "Picti"—painted.

Hostilities which Great Britain had to wage in defence of her colony in South Africa at frequent intervals between 1809 and 1877 are still commonly termed the Kaffir War ; but Kāfir is only an Arabic term for infidel or stranger, and none of the native tribes engaged in that war call themselves Kaffirs.

Nicknames were bandied pretty freely in the late European War ; British soldiers speaking of their German foe as Huns, while the French termed them Boches. So in the fourth century, Ammianus Marcellinus, who was never in or near Britain, would hear the Celtic foes of the Empire commonly referred to in Rome as Picti.

HERBERT MAXWELL.

Monreith.

Points from Foregoing Letters

STRONG indications that a few females of the native oyster, *O. edulis*, can produce young at an age of little more than a year, are reported by a group of investigators from the University of Liverpool. The number of shelled and just coloured larvæ born by one of the females was estimated at 240,000. About 12,000 larvæ (in the trochosphere stage) were counted in a drop of liquid after three days settlement. The authors also give a graph showing the relative weight distribution, in one-year old English native oysters.

F. W. James, Dr. J. S. Anderson and Prof. H. V. A. Briscoe find that when complex cobaltammines are dissolved in partially heavy water, complete isotopic interchange takes place, as reported by Erlenmeyer and Gartner, but that it requires some hours. Since the exchange can be stopped by rapidly distilling off the water from the solution or, better, by precipitating the complex, for example, as the mercurichloride, $[Co(NH_3)_6]Cl_3.HgCl_2$, a kinetic analysis of the reaction is possible and is being undertaken.

Mr. W. C. Pei announces that a fifth skull of early man in China has been discovered, and that a preliminary report by Prof. F. Weidenreich will appear shortly on the new material.

A very minute effect has been found by the Michelson-Morley-Miller experiment for determining the absolute velocity of the earth. Prof. W. B. Cartmel states that if one of the arms of the interferometer is inclined at a different angle from the other, a very large fringe shift may be observed even with a small interferometer. The experiment is simple, and can easily be repeated.

An increase in the number of radio atmospherics observed in Paris and also at Tunis and Rabat on December 12, 1936, is attributed by R. Bureau to an improvement in the propagation of the long waves over a great distance. This seems to be due to the ionospheric perturbations following upon the solar hydrogen eruption observed on the same date and at the same time at Greenwich by H. W. Newton.

In answer to Prof. Synge's criticism, Prof. Leigh Page submits an example indicating that his relativistic theory is able to dispense, in certain cases, with both the concept of the rigid measuring rod and that of the isochronous clock.

A method for the measurement under the microscope of fog-, cloud- and rain-droplets is described by N. Fuchs and I. Petrjanoff. The droplets are collected on glass slides coated with a mixture of vaseline and mineral oil, which practically prevents the evaporation of the droplets, without affecting their spherical shape.

The preparation of a highly active apo-dehydrogenase (a non-dialysable and heat-sensitive colloidal carrier, protein in nature) which is an essential component in the fermentation of alcohol, is described by M. Sreenivasaya. The purified preparation is 135-fold more active than the original yeast extract.

The activity of the hormone progesterone in inducing ovulation in the South African clawed frog, *Xenopus lævis*, is described by Dr. H. Zwarenstein. Ovulation was induced not only in adult normal animals but also in a certain proportion of immature normal animals and in others from which the pituitary gland had been removed. The hormone also acts upon ovaries *in vitro*.

In *Pisum sativum* the genes *R* and *A* (*R*/*r* = round/wrinkled, *A*/*a* = coloured/white flowers) have hitherto been found, according to Miss Caroline Pellew, to be independent in the normal structural type. The relation of these two genes in the three structural heterozygotes, found by Mrs. Sansome to have one interchanged chromosome, No. 1, in common, show that they are located in this chromosome in the normal structural type.

S. Paramasivan reports that the classical Jain paintings at Sittannavasal in South India have been executed in *fresco-secco* technique. He gives the results of analysis of the plaster and the pigments. Lime, carbon, yellow and red ochres, lapis lazuli and terre verte have been used as pigments.

S. Bhagavantam and Dr. A. Veerabhadra Rao have photographed the Raman spectrum of benzene vapour. While the principal line at 992 shows no shift, the line at 3061 in the liquid shifts to 3069 in the vapour and 3047 has not appeared in the vapour picture. Considerable alterations take place in the structure and intensity of the 'rotation wing' on passing from the liquid to the vapour.

The fact that Cario and Stille could not observe the negative bands of nitrogen and those first-positive bands which originate on vibrational levels higher than $v' = 14$, is due, according to Prof. J. Kaplan, to incomplete purification of the nitrogen in their discharge tubes.

R. N. Rai has calculated the conditions of reflection of radio waves from the ionosphere on the assumption that the group velocity vanishes. In addition to the usual results, a new condition for the extraordinary ray is found according to which the penetration frequency difference is only one fifth the expected results. This is in agreement with the observations made at the Physical Laboratory, University of Allahabad.

Research Items

Jungle Yellow Fever

ONE of the most interesting sections of the annual report for 1935 of the International Health Division of the Rockefeller Foundation deals with the occurrence and ætiology of what is termed "jungle yellow fever". This form of yellow fever is met with in Brazil in districts in or close to uncut forest or jungle, and in which the ordinary and only vector of yellow fever in town or city, the mosquito *Aedes ægypti*, is absent. One large area was discovered in 1934 in which more than sixty fatal cases had occurred, all with one possible exception acquiring their infection in rural areas in which this mosquito did not exist. Accumulated evidence suggests that jungle yellow fever usually occurs in man as an accidental infection secondary to an infection in a lower animal, much as bubonic plague occurs secondary to plague in rats and other animals. Evidence is presented that jungle yellow fever is secondary to the disease in the wild monkeys of the district, with transmission by mosquitoes of the genus *Hæmagogus*, for it was demonstrated that a large proportion of the monkeys of the district had a naturally acquired immunity to yellow fever, and that the infection could be experimentally transmitted by *Hæmagogus* sp. Work upon several other diseases—malaria, hookworm disease, diphtheria, yaws, tuberculosis and others—is surveyed in the report, as well as the aid given by the Foundation in furthering public health education throughout the world.

Genetics and Cytology of Hybrid Ducks

THE intergeneric hybrids between Aylesbury and Muscovy ducks have been studied genetically and cytologically by Prof. F. A. E. Crew and Dr. P. C. Koller (*Proc. Roy. Soc. Edinb.*, **66**, pt. 3). Aylesbury ♀ × Muscovy ♂ produces sterile males and grossly abnormal females with rudimentary ovary and no sex behaviour. Both sexes have a crest. In the reciprocal cross, the males are sterile while the females have a normal ovary, lay small eggs and show normal sex behaviour. The females are uncrested. The chromosomes of the parent species show no visible differences, consisting in each of five pairs of long chromosomes and numerous tiny granules, the highest chromosome count obtained being 72. Spermatogenesis shows numerous abnormalities, including short or multipolar spindles, binucleate spermatogonia, chromosome elimination, supernumerary post-meiotic divisions and giant multinucleate cells. One chromosome in the hybrid commonly lagged on the spindle in meiosis, probably because of a short terminal inversion. Since this would be insufficient to account for the phenomena of sterility, and also because the parent species show differences in nuclear and cell size and in rate of embryonic development, it is suggested that the abnormal gametogenesis is due to genetic factors which do not affect chromosome pairing, but which affect the harmonious relationship between chromosomes and spindle. This is conceived to be a result of profound differences in cell metabolism between the parental genera.

Chalcid Wasps of the Genus *Harmolita*

TECHNICAL BULLETIN No. 518 of the U.S. Department of Agriculture (September 1936) is a brochure forming a second revision of the species of the genus *Harmolita* (*Isosoma*) of America north of Mexico. Its author, Mr. W. J. Phillips, was, until lately, entomologist in the U.S. Bureau of Entomology and Plant Quarantine. It is seventeen years since the first revision of the genus was published, and in the present communication some twenty new species are described. The members of the group show a remarkable specificity of their host preferences, and it is only very rarely that a species will develop in more than one species of host. The author adds that he has never known a species of *Harmolita* to oviposit in plants of different genera. The extensive key which accompanies this paper refers to the females only: in half the known species males do not normally occur. The basis of the revision is the author's discovery of a new character in the sculpturing of the ventral aspect of the petiole and of its point of fusion with the ventral sclerite of the abdomen. This character is used with reference to identification of the males, where it appears to be better than other characters, although less valuable than with regard to females. The genus is one of definite economic importance since some of its members attack certain cereals and cultivated grasses.

Japanese Bopyrids

THREE recent papers by Dr. Sueo M. Shiino deal with interesting new Bopyrids ("Bopyrids from Tanabe Bay (3)". *Mem. Coll. Sci.*, Kyôtô Imp. Univ., Ser. B., **11**, No. 3; 1936. "Bopyrids from Shimoda and other Districts" and "Bopyrids from Misaki", *Rec. Oceanograph. Works in Japan*, **8**, Nos. 1, 2 and 3; 1936). The first is a continuation of his work published in this same journal in 1933 and 1934. Several new forms are described, mostly from crabs or shrimps. The new genus *Cataphryxus* has been created for *C. primus* in a former paper called *Epiphryxus primus*, the generic name *Epiphryxus* having been used by Nierstrasz and Brender à Brandis to describe a phryxid *E. adriaticus*. The second paper also includes new species, the material being collected at Shimoda, Nagasaki and Formosa. The new genus *Heterocepon* is here created for an Ione-like Bopyrid, closely related to *Dactylocepon*, *Metacepon*, *Anacepon* and *Hypocepon*, all having well-developed endopodites in the female and the medio-dorsal process absent. A table shows the differences between these genera. The third paper includes species collected near the Marine Biological Station at Misaki.

Spores of the Mushroom

MISS D. M. CAYLEY has made a detailed study of the spores and spore-germination in wild and cultivated mushrooms (*Trans. Brit. Mycol. Soc.*, **20**, Parts 3 and 4, November 1936). It has been stated that the wild mushroom has four basidiospores, and the cultivated form only two; but Miss Cayley has

shown that two of the three common varieties in cultivation have a number of spores varying from one to four. The origin of the cultivated mushroom is very obscure, and the present paper does not illuminate this question; but mycologists will be greatly interested in the discussion of circumstantial evidence for heterothallism in the genus *Psalliota*. Spores of wild mushrooms are haploid, and it is suggested that *P. campestris* and *P. arvensis* may be haplodiœcious. The cultivated mushroom is a saprophyte, but there is a certain amount of evidence that the wild form may be a facultative parasite upon the roots of grasses.

Some Diseases of the Potato

MODERN knowledge has not brought a new cure for the fungus causing wart disease of potatoes, but numerous investigations have elucidated the incidence and pathogenic cycle of the disease. The Ministry of Agriculture and Fisheries has provided an admirable summary of modern findings in its new Advisory Leaflet No. 274, "Wart Disease of Potatoes". This replaces the old Leaflet No. 105, and perhaps the most striking addition is a list of solanaceous plants, other than the potato, which have been infected artificially with the causal fungus *Synchitrium endobioticum*. Such hosts do not, however, seem to play any practical part in spreading the disease under natural conditions. The subject matter of all sections of the leaflet has been entirely rewritten, and the list of immune varieties has been brought up to date. Advisory Leaflet No. 278, which replaces Leaflet No. 164, makes a clear presentation of the menace of the virus disease leaf roll to the potato crop. Rogueing diseased plants from isolated crops with very slight incidence of the malady, and fumigation of seed-tuber stores to eradicate transmitting insects, are the control measures recommended.

Glaciation of Bantry Bay District

THE results of a study of the evidences of the latest glaciation in the neighbourhood of Bantry Bay have recently been recorded by A. Farrington (*Sci. Proc. Roy. Dublin Soc.*, **21**, No. 37; 1936). The area was invaded by an ice-sheet coming from the north-north-west over the ridge formed by the Caha and Slieve-miskish Mountains, which were overwhelmed to a height of about two thousand feet. The Bay was filled with ice which escaped south-westwards along the Bay itself; north-eastwards into the mountain valleys, where fine terminal moraines are found; and south-eastwards as far as Skibbereen. The terminal moraine of this sheet can be traced for about twenty miles from the pass of Keimaneigh to Skibbereen. The press of ice coming down the Glengarriff valley was congested at the head of the Bay, and there is evidence of much differential movement within the ice-mass. Drumlin trains mark the north-east and south-west ice movements, but in the south-east direction they are poorly developed. The occurrence of erratics of typical crinoidal limestones of Lower Carboniferous type on the south shore of the Bay seem to have been derived from a former exposure of Carboniferous limestone which is now covered by the waters of the Bay. Otherwise they must have been carried from the outcrops at Kenmare without leaving a single example on the ranges to the north of the Bay.

Obtaining Upper Air Data

A RECENT report circulated by Science Service of Washington, D.C., deals with a new development of upper air research. The sounding balloon, with recording instruments that are not at once recovered, is not equal to the demands of modern weather forecasters for prompt information about the physical state of the upper air. This failure has led to the construction in various countries of devices carried by balloons which send out automatically, by radio, reports of pressure, temperature and humidity. The latest of these comes from the California Institute of Technology. Carried by a balloon 5 feet in diameter, and emitting on a wave-length of 1·7 metres, it has already yielded a sounding up to 30,000 feet. L. E. Wood, graduate assistant of the Institute, has designed the meteorograph, and has developed for it a 2-volt storage battery that weighs only 4½ gm. Fifty of these batteries are used in series in place of the ordinary dry battery system. The radio transmitting apparatus is the work of Capt. C. O. Maier, of the U.S. Signal Corps. A very small tube emits a constant signal, which is interrupted by a timing device that translates the data for broadcasting. It is a modified watch that develops twenty-five times the power of an ordinary watch. Power for the radio comes from three dry cells, of 135 volts in all, and three small storage batteries. The signals are recorded on an electrically operated tape.

A New Actinometer

As a result of experiments carried out in the laboratory of the Meteorological-Hydrographical Institution at Stockholm, A. Angström has produced a new design of actinometer. This is described under the heading "A Simple Actinometer" in paper No. 9 of the Institution reprinted from *Gerlands Beiträge zur Geophysik* (**48**, 303; 1936). The author suggests that in some ways it would be better to reduce rather than to increase the number of actinometers; but this one was designed and made for the glaciological expedition of Prof. H. Ahlmann to Iceland in the summer of 1936, and worked well, and as it was felt also that a very simple and portable instrument is in demand for meteorological work, it seemed desirable to publish a description of it. The new actinometer consists of a thermometer with blackened spiral bulb the plane of which is perpendicular to the graduated stem. Solar radiation is admitted through an aperture in the lid of a cylinder which surrounds the thermometer. At the bottom end of the cylinder is a Fuess aspirator similar to those used on psychrometers. When the inside of the apparatus has been brought to air temperature, which takes about two minutes, the aspirator is removed and the cylinder is trained on the sun with the aid of a diopter. An exposure of 90 seconds is made, and the rise of temperature is observed. This rise is for a particular instrument nearly proportional to the intensity of the solar radiation. The constant by which the rise must be multiplied to get the radiation intensity is found for each instrument by comparisons made with some standard instrument of more elaborate pattern. Figures are quoted which suggest that the error arising from the use of this simple actinometer will usually be less than three per cent, which for many purposes is quite accurate enough. An observation can clearly be made in a very short time.

Clarification of River Water

IN an account of an extensive series of experiments on the clarification of water from the River Vltava in Czechoslovakia (*Proc. Masaryk Academy of Work*, **10**, 233; 1936), Prof. J. Milbauer concludes that crude aluminium sulphate is the most satisfactory clarifying agent for this and other river waters. In his investigations it was found that the addition of 100 mm. of the salt per litre gave the best results. Pure aluminium sulphate was not so satisfactory, probably because the silica and other impurities in the crude salt play an important part in flocculating the aluminium precipitates. The most suitable temperature was 10° C.; below this point flocculation was slow. Clarification was favoured by hydrogen ion concentrations up to pH = 4·2. Beyond this it decreased to a minimum at pH = 5·0. The addition of such substances as calcium hydroxide, ferric sulphate or silica had no perceptible influence, although addition of excess of charcoal was favourable to sedimentation. Cheap natural products like chalk, felspar, clay, dolomite powder, coal dust, peat or infusorial earth had no useful action on the process. Addition of colloids (proteins, saponine, silicic acid, etc.) were definitely detrimental, but kaolin and certain industrial wastes and the ash from a refuse-burning station were beneficial in assisting the flocculation of the precipitates from the addition of aluminium sulphate to the river water. Pre-treatment with ozone, chlorine, carbon dioxide or sulphur dioxide was not advantageous.

Magneto-optic Method of Chemical Analysis

THE work of Allison and others on the magneto-optic apparatus has been called into question by certain observers who have been unable to observe the 'minima' which are claimed to be characteristic of the substances under observation. Gordon Hughes has recently described a photographic method whereby small changes in light intensity have been successfully detected and the reality of minima conclusively demonstrated (*J. Amer. Chem. Soc.*, 1924; 1936). More than 2,300 photographs taken in this investigation show that there is a small effect—the change of light intensity for a minimum being 0·7 per cent—which is characteristic of the substance under test in the apparatus. Water-blanks showed approximately zero percentage change. The presence of foreign materials did not change the magnitude of the intensity change for a minimum. The direction of the effect was found to be dependent on the direction of the magnetic field in the coils, and to reverse with the setting of the Wollaston prism on either side of the critical 45° position. The measured photographic effect was found to occur only at positions of minima which had been previously determined by repeated visual observations. It is concluded that the photographed effect is identical with the visual effect and that the latter is real, despite the not unexpected inability of certain workers to observe it.

Locomotive Furnace Control

THE principle of furnace control by means of the carbon dioxide concentration in the flue gases is well known in its application to stationary units. In practice, conditions of firing and air supply are regulated, and heat losses in the flue gases (carbon monoxide and hydrogen) are eliminated by maintaining the carbon dioxide at a fixed optimum percentage. Measurement of the carbon dioxide content is frequently carried out by a thermal conductivity method, but unfortunately this is complicated by the fact that both carbon monoxide and hydrogen affect the readings of any thermal conductivity meter. On application of this principle to locomotive furnaces, where conditions of firing and air supply are not so readily controlled as in stationary plants, the presence of carbon monoxide and hydrogen has a very pronounced effect on the carbon dioxide meter reading. V. Binns and S. Bairstow, in a paper read before the Institute of Fuel on November 25, emphasized this factor and outlined investigations which had been made with the view of assessing the accuracy of thermal conductivity methods of gas analysis when applied to locomotive flue gases. Results of such investigations proved that this method can be adopted, providing appropriate corrections are made to meter readings. The method of correction is simple and is well illustrated in the paper by a rapid graphical method.

Strength of Materials

IN a paper entitled "The Relationship between Mechanical Tests of Materials and their Suitability for Specific Working Conditions" read before the North-East Coast Institution of Engineers and Shipbuilders on December 18, Dr. N. P. Inglis dealt with the various stipulations most or all of which are usually included in the specification of an important steel forging; he analysed critically each of these from the point of the useful information it provides and demonstrated that for service under particularly severe conditions, such as high temperature, mechanical tests require to be supplemented by precise knowledge of chemical composition, method of manufacture, amount of ingot croppage and of hot work, and the nature of the heat treatment given. It was, however, also shown that from the ordinary mechanical tests, by the adoption of suitable procedure, much more than the usual amount of information could be derived and, as an example, the value of the Izod test both as a guide to the correctness or otherwise of heat treatment in certain alloy steels, and also as a means of indicating the presence of laminations or other effects of segregation, was quoted. In this last connexion, the position of the notch must be suitably arranged and, following from his discussion of this point, the author suggested that microscopic examination of Izod test fractures would add materially to the information of the mere figures of the test. Among other matters, the deterioration of mechanical properties under severe service conditions was discussed, and the results of two groups of notched bar tests were cited. The first of these referred to a number of samples of different qualities of steel subjected, during fifteen months' service, to temperatures of 410°–430° C., and it was here shown that while some samples depreciated to Izod values 14–80 per cent of their original figures, in others the initial value was fully maintained. In the second group, similarly varying results, arising from different preparatory treatment, were obtained in samples subjected to subnormal temperatures of − 30° C. while in service.

Mandibles of Peking Man*

THE late Dr. Davidson Black, honorary director of the Cenozoic Research Laboratory of the National Geological Survey of China, at the time of his lamented death was engaged on the study of the mandible of Peking man. Further material discovered since then has necessitated some modifications in the conclusions at which he arrived. This new material has now been incorporated in a study by his successor, Prof. Franz Weidenreich, in which he has been able to include the plates which Dr. Black had prepared.

The number of mandibles, or parts of mandibles, of *Sinanthropus*, which has now been obtained from Choukoutien, is eleven, of which six are juvenile and five are adult. [A further specimen was found in October last.] They are of both sexes. In his prefatory remarks, Prof. Weidenreich points out that the importance of the mandibles of fossil man has always been recognized, and given rise to considerable discussion, since the discovery of the Naulette jaw in 1866; but the jaw of *Sinanthropus* is of special interest. All the known lower jaws of fossil man, with the exception of Heidelberg and Piltdown, form a group which is distinguished from modern man in lacking a chin, in being more massive and bulky and in having the relief of the surface strongly developed. In these respects *Sinanthropus* conforms; but as the teeth constitute the essential factor in its classification, it is of importance to determine how far the lower jaw fits into the framework. Its significance is enhanced by the fact that, unlike the other jaws of fossil man, all the specimens come from one site, though from different levels.

In its bearing on the evolutionary problem, the evidence of *Sinanthropus*, the most primitive and geologically the oldest hominid known, is crucial. It should point the way to the solution of the problem whether the modern jaw is derived from an ape-like ancestral jaw by the retraction of the teeth and the development of the chin, modifying an original prognathism, or from a 'mesogeneiotic' form which develops on one side into the prognathism of the anthropoid, and on the other into the orthognathic form of modern man. The high antiquity of the Heidelberg jaw, combined with its resemblance to Neanderthal man, has been thought to militate against the former alternative, which demands that the earlier the jaw in a chronological sense, the nearer its resemblance should be to the ancestral type. On this question, the position of the Peking mandible should be decisive.

Prof. Weidenreich, after describing in detail the eleven mandibles now available, and recording and discussing their measurements, passes on to consider the peculiar characteristics of *Sinanthropus* and its comparison with other types, as well as the place of Peking man in the evolutionary scale, incidentally recording some interesting conclusions on *Australopithecus* and the Piltdown jaw.

As regards sexual differences, it is evident that two types, a large and a small, are represented in the mandibles. The idea that they belong to different races may be discarded. If the difference is due to sex, as is held, the ratio in size of female to male is much lower than in recent man, and more closely resembles that of the anthropoids. In *Sinanthropus* the ratio of small to large is 85·0 per cent; in modern man (Mongol), of female to male it is 92·4 per cent, in orang, 78 per cent, gorilla, 80 per cent and chimpanzee (approximately) 87 per cent.

As regards the special character of the mandible, the male is much larger, and bulkier than that of modern man; but this does not hold of the female, although the female ramus exceeds in height and breadth that of the Mongol of to-day. In height of body the symphysis height of 40 mm. reaches the upper margin of recent man, though the two measurements do not exactly conform. The *Sinanthropus* jaw has a higher alveolar and lower basal plane than modern man. The bicondylar breadth of 146·4 mm., it is interesting to note, is greater than that of the Eskimo, 140·0 mm., which is exceptionally broad, although the bigonial breadth, 108·6 mm. is below the Eskimo measurement of 130 mm. In both, measurements the female jaw is within the range of modern man. The angle of inclination of the frontal part of the jaw is the lowest known in hominids excepting the Heidelberg jaw, which is the same, namely, 60°. Another striking feature is the parallellism between the alveolar and basal planes, which is present also in orang and gorilla.

The shape of the alveolar arch presents a very characteristic picture in all adult specimens. Compared with recent man, the arcade shows a horseshoe-shaped, long and relatively narrow curve with its frontal part equally rounded in the region of the canines and incisors, and not flattened as in recent man. The free ends of the arches come close to each other.

In regard to the relief of the surfaces, one of the most outstanding features is the absence of chin (*mentum osseum*). In one specimen the area occupied by the roots of the frontal teeth is much larger than has been observed in any other known hominid, including the Heidelberg jaw. This feature, together with the strong inclination of the frontal part, points to a very primitive stage. There is, however, the beginning of a real mental spine, which has never been observed before in any of the Neanderthal mandibles, except La Chapelle-aux-Saints.

The juvenile mandibles exhibit the same qualities as the adult in regard to their bulkiness, even when sexual differences are considered. As to the anterior alveolar arch, it is noted that in the only one concerned, it is much longer and more widely stretched than in recent man, and essentially longer than in the adult *Sinanthropus*. A distinct shortening takes place during dentition, in which *Sinanthropus* apparently follows modern man and differs fundamentally from the anthropoids.

In comparing *Sinanthropus* with other forms, Prof. Weidenreich records his agreement with Prof. R. Dart and Dr. R. Broom that *Australopithecus* is neither chimpanzee nor gorilla, but comes well within the human line of development. This conclusion he bases on the character of the teeth, which resemble those of *Sinanthropus* (to be dealt with in a later monograph) rather than those of chimpanzee or

* The Mandibles of *Sinanthropus pekinensis*: a Comparative Study. By Franz Weidenreich. (Palæontologia Sinia, Series D, **7**, Fasc. 3.) Pp. 162+xv plates. (Nanking and Peiping: National Geological Survey.)

gorilla. As regards the mandible, comparison is difficult, owing to the imperfect state of the *Australopithecus* mandible. Differences, however, from that of chimpanzee and gorilla are to be noted as well as resemblances to juvenile *Sinanthropus*.

The two mandibles of special importance in view of their rivalry with *Sinanthropus* on the score of antiquity, are Heidelberg and Piltdown. In regard to Piltdown, Prof. Weidenreich reaffirms his previously expressed inability to accept this jaw as that of a human being. To accept it, he maintains, would imply that in England lived a hominid with the brain case of recent man and an anthropoid-like jaw, while at the same time there was in the Far East another human being with the most primitive brain known hitherto, and a jaw distinctly more closely related to that of recent man than to that of the chimpanzee. The Piltdown jaw, in fact, as has been demonstrated by H. F. Friederichs, approaches most nearly the jaw of an orang, and no direct comparison between it and the mandible of *Sinanthropus* is possible. Piltdown does not come within the line from which *Sinanthropus* was derived, but belongs to the highly specialized group orang, chimpanzee, gorilla—forms removed from the human line.

With regard to the Heidelberg mandible, the antiquity of this has been called into question, but on the other hand the Steinheim skull has been considered to belong to the third Riss-Würm interglacial or even earlier. Yet it approaches recent man more nearly than does the Neanderthal type. The general conclusion seems to be valid that the geological antiquity of hominid finds in Central Europe does not guarantee morphological primitiveness. The high geological age claimed for the Heidelberg find does not decide anything in regard to its phylogenetic precedence. The teeth of Heidelberg show none of the pithecoid characters which mark *Sinanthropus*, though the latter is of about the same age. In Heidelberg man, small teeth are combined with a bulky jaw which is no sign of primitiveness. None of its distinctive features, to which attention has been directed, are really a mark of primitiveness.

Of the Neanderthal mandibles, the Ehringsdorf adult is closest to *Sinanthropus*.

On the general evolutionary problem, the evidence of the *Sinanthropus* mandible points to the conclusions: that Peking man is a direct forerunner of recent man; that only a general line which human evolution follows can be traced to a remote destination, and that regressive and progressive factors are to be found in every fossil mandible to a certain extent; that *Sinanthropus* does not represent a 'specialization', and that certain characters which may be regarded as a mark of primitiveness are found associated in the *Sinanthropus* mandible; and that the development of certain other characters such as the beginning of development of a mental trigonum, makes it quite possible that Peking man may have possessed the faculty of speech, as many indications in his cultural life appear to suggest.

Science Masters Association

Annual Meeting

THE thirty-seventh annual meeting of the Science Masters Association was held on January 5–8 in Manchester. Only once before has the Association been north of Birmingham for its meeting, and never before to Manchester, but the generous activity of the host—the University of Manchester—and vigorous efficiency of the local committee, provided one of the most thoroughly satisfying meetings the Association has ever had. There were as usual exhibitions by leading publishers and manufacturers of scientific apparatus; there were demonstrations by the University science departments, and a particularly complete exhibition at the College of Technology, whither the whole meeting was bodily transferred by bus for one evening; and an unusual feature for a provincial meeting was the members' exhibition, never before held outside London.

The president for the year was the Vice-Chancellor of the University of Manchester, whose presidential address was as happy in delivery as it was penetrating in substance. He reminded his audience that the university teacher of medicine, himself a specialist, must train men so that all may have the general grounding which makes the good 'general practitioner', and yet so that the ten per cent who are to be specialists may have a proper foundation for their work; and noted a parallel with the task of the science master, who must use his specialist knowledge to train the ninety per cent of citizens as well as the ten per cent of technicians. He pleaded for an early study of living things and their interdependence, even at the expense of the exact sciences, recalling the unique appeal of biology and its humanizing and broadening influences. He also expressed the hope that universities and schools would soon find an escape from a position in which each accused the other of fostering early specialization. It is for the teacher a peculiar merit of biology that it is not a science where control is simple or laws easy to arrive at; thus it affords a link between the physical sciences and ordinary life.

Other lectures, and the demonstrations arranged in the University science departments, were generally relevant to the recent research work going on in the University. Prof. W. L. Bragg demonstrated methods and results of crystal-structure investigation, and Mr. R. W. James, to whom the Association was able to offer the first public congratulations on his election to the chair of physics at the University of Cape Town, lectured on "The Architecture of Solid Matter". Prof. D. R. Hartree demonstrated the differential analyser. Perhaps the most popular exhibition was in the Chemistry Department, where Dr. G. N. Burkhardt had arranged a comprehensive series of demonstrations of recent spectroscopic work on vitamins and carotene. Prof. I. M. Heilbron, speaking on "Modern Technique in Biochemistry", showed how by colour separation and distillation it is possible to separate nearly-related substances in minute quantities; vitamin D_3 has thus been isolated, and vitamin A nearly so.

Prof. T. H. Pear educated and entertained a large audience concerning "The Borderland between Physics and Psychology"; he convicted of error any who still believed in the reliability of their senses, and considered how far psychology might dare to use the methods of the older sciences. Biologists found much of special interest to them at the meeting; in addition to demonstrations in the Botany and Zoology Departments dealing with genetics, ecology, the biology of injurious insects and pest-control in practice, there were lectures by Prof. H. Graham Cannon on "The Mechanics of Cell-Division" and by Prof. J. Montagu Drummond on "Some Practical Applications of Botanical Science".

There was a large attendance at a discussion on the Association's recent report on the "Teaching of General Science". The president took the chair, and Mr. C. L. Bryant (Harrow), chairman of the sub-committee which drew up the report, introduced the subject; Dr. A. W. Barton (Repton) and Mr. J. Clement Platt (Chadderton) opened the discussion. Dr. Barton addressed himself to the question, "Do we want general science?", and Mr. Platt to the question, "Is this the sort of general science we want?" Both commended the report with minor qualifications: Dr. Barton considers that physics and chemistry are the best branches from which to learn scientific principles, and biology a good field for their application; Mr. Platt wants a better knitting of the different branches. Subsequent discussion took three main lines, which were stressed by many speakers: that the introduction set forth clearly, even brilliantly, the case for general science; not a voice was raised against it. That the actual syllabus proposed was impractical (no speaker thought it possible to cover the ground suggested having regard to proper teaching method and due time for practical work, in four years at four periods a week; and some were emphatic that the broad-sheets must be re-written); and that since four periods a week was an improperly small time for science, everything depended upon how the sub-committee's final report dealt with the rest of the time. Mr. Bryant replied wittily, and everyone awaits the final report with impatience; it can scarcely come in less than twelve months.

At the business meeting, Sir Cyril Ashford—member of the Association since its formation in 1900—was elected president for next year. In succession to Dr. T. J. Baker (Birmingham), Mr. J. W. Cottingham (Barnsley), Mr. W. R. B. Brooks (Lowestoft) and Mr. W. J. R. Deeks (City of London), who retired from the Committee, the meeting elected Messrs. C. L. Byrant (Harrow), W. G. Rhodes (Firth Park, Sheffield), E. M. Rogers (Charterhouse) and H. P. Ramage (Gresham's, Holt). Mr. S. V. Brown (Liverpool Institute) was re-elected general secretary, Mr. B. M. Neville (William Ellis), honorary treasurer and Mr. R. E. Williams (Department of Education, (University of Oxford), annual meeting secretary.

Between five and six hundred science masters attended the meeting, and the University spared no pains to make them welcome; a University reception followed the presidential address.

The U.S.S.R. Academy of Sciences and the Third Five-Year Plan

THE Russian Academy of Sciences was founded in 1725 by Peter the Great as an "assembly of the best learned men" who were supposed to carry on research, to train young men of science, and to study the country's natural resources. Under the old regime, the Academy devoted most of its energies to abstract research, surveys of natural resources and the study of Asiatic languages. Its character did not change immediately after the Revolution and it remained out of touch with the economic needs of the country for some time. The change came in 1929 when the function of the Academy was defined as the direction of the whole volume of scientific knowledge towards the reconstruction of national economy, and a number of members of the Communist Party, distinguished in various branches of technological science, were included in the Academy. In 1934 the Academy was made directly responsible to the Government of the U.S.S.R. and its headquarters were transferred from Leningrad to Moscow, in order to bring it into closer contact with central administrative bodies, particularly with the State Planning Commission. The headquarters of the Academy, its central administrative departments and its principal research institutes and laboratories are now in Moscow, where new buildings are being built to house the various sections.

Under its new constitution, adopted in November 1935, the aims and functions of the Academy are defined thus: First, the Academy is not merely a centre for the passive registration of scientific facts, but also an active body for the development of scientific thought. Secondly, the Academy has to study and to develop world scientific achievements with the view of applying them to the work of construction. Thirdly, the Academy has to utilize the achievements of science to further the country's progress towards a classless order of society.

The Technical Section of the Academy was charged with the duty of seeing that the results of research were introduced into industry. It has to maintain contact not only with the research institutes and laboratories of the Academy itself, but also with the various commissariats and industrial enterprises. Among the groups now functioning under the Technical Section are those dealing with power, mining, technical physics, technical chemistry, technical mechanics, automatic processes and tele-mechanics.

Another function of the Academy is to study the natural resources and productive forces of the country, and to promote their rational utilization. For a number of years, the Council for the Study of the Natural Resources of the U.S.S.R. has been sending out expeditions for these purposes. Branches of the Academy have been established in various parts of the country to direct the work of prospecting and surveying. The first preliminary general survey of the geological, chemical and economic resources

has already been completed. Now, with the approach of the Third Five-Year Plan, the activities of the Academy in this field are to undergo a decided change. Attention will be concentrated on key positions, and the number of the Academy's branches will be reduced, or handed over to the local authorities. A further function of the Academy is to study the cultural and economic achievements of mankind and to help in their rational application for the building-up of the new society. The main responsibility for this work falls upon the Social Sciences Section.

The work of the Academy in the immediate future is to aid the State Planning Commission in the drawing up of the Third Five-Year Plan. The main efforts of the Academy's various institutes will be directed towards the solution of the following ten problems, outlined at a session held last March. (Needless to say, these problems do not comprise the whole work of the Academy and its research workers but, for the moment, they are the leading and dominant ones.)

(1) To develop geological, geochemical and geophysical methods of prospecting for useful minerals, particularly tin, rare metals and oil.

(2) To solve the problem of power by creating a unified electric power system throughout the U.S.S.R., with high-voltage transmission.

(3) To rationalize and extend the use of natural gas and by-product gas from industrial plants.

(4) To find a new type of fuel for internal combustion engines (study of chain reactions and explosion processes, internal combustion motor and electric automobiles).

(5) To rationalize technological processes in chemistry and metallurgy.

(6) To help in raising the grain yield of the country (research in seed selection, soil chemistry, plant biology, fertilizers and the mechanization of agriculture).

(7) To establish scientific bases for the development of animal husbandry and fisheries.

(8) To develop telemechanics (long-distance control of machinery) and to extend automatic processes in industry through application of theoretical physics.

(9) To draw up the balance sheet of the national economy of the U.S.S.R. so as to serve as a scientific basis for the Third Five-Year Plan.

(10) To study the history of the peoples of the U.S.S.R.

Science News a Century Ago

Robert Macnish (1802–37)

DR. ROBERT MACNISH, a brilliant physician and man of letters, who died on January 16, 1837, was born at Glasgow on February 15, 1802, the son and grandson of medical men. He obtained the degree of master of surgery at the early age of eighteen years, and first served as assistant to a general practitioner for eighteen months. He then went to Paris, where he attended the lectures of Broussais and Dupuytren and made the acquaintance of Gall, who pointed out Macnish to his fellow students as presenting a remarkable development of the organ of comparison.

On his return to Glasgow in 1825, Macnish obtained the degree of M.D. with a thesis on "The Anatomy of Drunkenness", which was published in 1827. Enlarged editions afterwards appeared and enjoyed a wide popularity. The work is of some historical value as being the first attempt to study drunkenness in its physiological aspects rather than as a crime. Macnish's next most important medical publication was "The Philosophy of Sleep", and was mainly based on the doctrines of Gall. His interest in phrenology is further shown by the publication in 1836 of an elementary treatise on the subject in the form of question and answer. At about the same time, he brought out a new edition of Amariah Brigham's "Remarks on the Influence of Mental Cultivation and Mental Excitement upon Health", to which he added numerous notes. He also contributed numerous articles to various periodicals, the best known of which, published in *Blackwood's Magazine*, was the tale entitled "Metempsychosis", which he wrote under the *nom de guerre* of "Modern Pythagorean". His collected tales, essays and sketches were afterwards published under this title with an account of his life by his friend Dr. David M. Moir. His premature death was due to an attack of influenza.

Production of Minerals in France

AT a meeting of the Statistical Society held on January 16, 1837, a paper by the chairman, G. R. Porter, was read entitled "A Statistical Account of the Mineral Products obtained in France during the year 1834; taken from official documents". In his opening remarks, the author said, that though in Great Britain no systematic effort had been made to gather statistics on the iron and coal mines, the French Government had recently deputed M. Le Play to ascertain the capability of every iron works and nearly every coal-field in England.

Mr. Porter's review of the mineral resources of France was divided under the following heads: iron-works; fuel; metals; salt, alum and copper ore; quarries, and operations connected with mineral substances. The quantity of iron ore obtained in France in 1834 was 1,551,473 tons, the number of smelting furnaces 374 and the weight of iron produced 221,886 tons. There were in use 97 furnaces for converting ore at once into malleable iron and steel, by a peculiar process used in Corsica, the production being 8,531 tons of iron and 399 tons of steel. There were also 1,230 forges for converting cast into malleable iron, and 1,556 rolling, drawing and slitting machines. The total value of the French iron manufacture was £3,492,519, and the number of men employed 31,704. Five sixths of the fuel used in iron manufacture came from the French forests. During 1834, 140 coal mines were being worked, and the coal produced was 1,550,530 tons.

George Richardson Porter, the author of the paper, was born in 1792 and died in 1852. Failing in business as a sugar-broker, he devoted himself to economics and statistics, and the Statistical Department of the Board of Trade was established mainly under his supervision. Among his writings was "The Progress of the Nation from the Beginning of the Nineteenth Century", the third edition of which appeared in 1851.

Rev. Baden Powell on the Dispersion of Light

AT a meeting of the Royal Society held on January 19, 1837, the Rev. Baden Powell, then Savilian professor of geometry at Oxford, read a paper entitled "Researches towards establishing a Theory of the Dispersion of Light". An abstract of the paper said:

"The author here prosecutes the inquiry on the dispersion of light which was the subject of his former papers published in the Philosophical Transactions for 1835 and 1836, extending it to media of higher dispersive powers, which afford a severer test of the accuracy of M. Cauchy's theory. He explains his method of calculation and the formulæ on which his computations are based. On the whole he concludes that the formula as already deduced from the undulatory theory, applied sufficiently well to the case of media whose dispersion is as high as that of oil of anise-seed : or below it, such as nitric, muriatic and sulphuric acids, and the essential oils of angelica, cinnamon, and sassafras, balsam of Peru and creosote. It also represents, with a certain approximation to the truth, the indices of some more highly dispersive bodies."

Faraday on the Views of Prof. Mossotti

THE evening meetings of the Royal Institution, said the *Athenæum*, began on January 20, 1837, when considerable interest was excited by its being known that Faraday was to deliver a lecture on the views of Prof. Mossotti, of Corfu, who has lately promulgated an opinion, that one general law would account for those forces of matter which are exhibited in universal gravitation, cohesion, and electrical attraction and repulsion. Faraday began by observing that the want of such general law had been strongly felt, and had latterly been more than hinted at by Babbage, Roget and other philosophers. He went on to speak of the nature of the forces of gravitation, cohesion and electrical attraction and repulsion, and then, according to the *Athenæum*, said : "Hence there is such an adjustment of these forces, that at certain distances, matter acts inversely as the square of the distance, producing gravitation ; but when the particles are nearer to each other, the powers are balanced, producing the state of cohesion ; and when they are still nearer, they exert that repulsion, which keeps the particles of every solid and fluid body out of actual contact".

Robert Thornton (1768–1837)

DR. ROBERT JOHN THORNTON, who was a prolific writer on botany and medicine, was born in 1768 and died on January 21, 1837. He received his medical training at Trinity College, Cambridge, where he attended Prof. Thomas Martyn's lectures, and at Guy's Hospital, where he was a pupil of the eminent surgeon Henry Cline. He qualified in 1793, and after further professional studies in Edinburgh, Dublin and Paris, and also in Holland and Germany, set up in practice in London, where he was for some time physician to the Marylebone Dispensary and lecturer on botany at Guy's Hospital.

At an early stage of his career, Thornton ruined himself by the publication of a magnificent folio in which contemporary artists and poets collaborated entitled "The Temple of Flora or Garden of the Botanist, Poet and Philosopher ; with picturesque plates in illustration of the Sexual System of Linnaeus" (1799–1804). He was also the author of "Practical Botany" (1808), "The Philosophy of Botany" (1808), "Outlines of Botany or an Introduction to that Science" (1810), and "A Grammar of Botany" (1811). His medical writings included "The Philosophy of Medicine" (1799–1800), "Vaccinae Vindiciae or a Vindication of the Cow Pock" (1806) and "The Prevention and Cure of the Venereal Disease" (1817).

Societies and Academies

Paris

Academy of Sciences, December 14 (*C.R.*, 203, 1301–1406).

LOUIS BOUVIER : Complementary observations on the claws of decapod crustaceans belonging to the Astacomorph section.

SERGE BERNSTEIN : The formula of approximate quadrature of Tchebycheff.

JEAN ANDRÉ VILLE : The convergence of the median of the n first results of an infinite series of independent experiments.

FRÉDÉRIC ROGER : The limits of a function at a point.

ALEX. FRODA : The properties characterizing the possibility of measuring multiform and uniform functions of real variables.

BERNARD SALOMON : Certain classes of reducers of oscillations of machine shafts.

DOUCHAN AVSEC : The ratio λ/h for vortices in longitudinal bands.

JEAN LABAT : The importance of Reynolds number in trials on small models. Results of an experimental study, using chronophotographs of particles of aluminium in suspension in water.

CHARLES CHARTIER : The structure of the general flow round a helix. Two diagrams based on a study by chronophotography.

L. CAGNIARD : The propagation of intumescences in directions with or against the current in rivers.

BERNARD LYOT : The spectrum of the solar corona in 1936, wave-lengths and the intensities of the emission lines.

DANIEL CHALONGE and HORIA SAFIR : Study of the variations of γ-Cassiopeia.

MME. MARIE ANTOINETTE TONNELAT-BAUDOT : Relation between the action function and the force which acts on the electron.

PAUL SOLEILLET : The interpretation of phase in the matrices of quantum mechanics.

GABRIEL DUCH : The determination of the surface tension of a liquid by the formation of drops at the end of a capillary tube in which the elongation of the meniscus is observed.

JAMES BASSET : Thermal exchanges in nitrogen and in hydrogen at ultra-pressures up to 6,000 kgm./cm.^{2}.

MARCEL LAPORTE : The production of white light by the electrical luminescence of gases. The method is based on the production of discharges of very high intensity of very short duration through a gas (xenon), the discharges being repeated with a frequency sufficiently high to make use of the persistence of light impressions. In the arrangement described, the oscillating discharge has a period of 8×10^{-6} sec.

J. J. PLACINTEANU : The electronic nature of light.

CLAUDE CHARMETANT : The electrolysis of ferrous chloride, bromide and iodide and of ferric chloride in mixtures of water and ethyl alcohol.

JEAN JAFFRAY : The discharge spectrum in air of high-tension magnetos.

B. ROSEN and MLLE. NINA MORGULEFF : Spectroscopic study of the constitution of sulphur vapour. Additional proofs of the existence between 3600 A. and 6000 A. of two absorption systems of sulphur vapour, one of which forms part of the principal system of S_2.

FRANÇOIS GRISEL : The flow of water, under constant pressure, through a mass of concrete. The volume of water passing through is a linear function of the logarithm of the time ; hence the permeability of a specimen of concrete, under constant pressure, can be determined by measuring the volume passing during a relatively short time.

GABRIEL VALENSI : The kinetics of the oxidation of copper at a high temperature.

JACQUES BÉNARD : Study of the stability of solid solutions between the lower oxides of iron and cobalt.

MAURICE DODÉ : Remarks on the conditions of possibility of heterogeneous reaction with a gaseous phase, in the case of miscibility of condensed phases.

JEAN COURNOT and MARC BAUDRAND : The corrosion of joints. Details of results obtained with riveted joints. For light alloys, cadmium-plated rivets give the best results. For joining steels, light alloy rivets without cadmium give the best auto-protection.

ETIENNE VASSY : The variation of the absorption coefficients of ozone and the temperature of the upper atmosphere.

EMMANUEL VOYATZAKIS : The compounds of nitroprussides and hexamethylenetetramine.

MLLE. ALICE LACOURT : Application on the micro-analytical scale of the methods of quantitative organic analysis by hydrogenation.

MAXENCE MEYER : The synthesis of $\alpha\alpha'$-diethoxy-acids with straight chains.

ANTOINE WILLEMART : Researches on the dissociable anthracene oxides : the photoxides of 9-phenyl-10-methylanthracene and of 9-phenyl-10-ethylanthracene.

GEORGES DARZENS : A new general method for the condensation of dichloracetic ester with ketones and aldehydes by the use of very dilute metallic amalgams. A general method for preparing compounds of the types $RR'.C(OH).CHCl.CO_2C_2H_5$ and $R.CH(OH)CHCl.CO_2C_2H_5$. The yields are high.

LÉON PALFRAY, SÉBASTIEN SABETAY and JEAN KANDEL : The catalytic hydrogenation of α-ionone, ionol, dihydroionol, tetrahydroionol, dihydroionone, tetrahydroionone.

HENRI LEFEBVRE and GEORGES LE CLERC : The thermomagnetic study of the iron catalysts utilized in the synthesis of hydrocarbons by the Fischer method.

PIERRE CHOUARD : Building up the stem in the Monocotyledons.

RAYMOND-HAMET : A new alkaloid, formosanine, extracted from *Ourouparia formosana*.

GEORGES FRON : The fight against tracheomycoses in plants. An account of the beneficial effects of the neutral sulphate of *o*-oxyquinoline by increasing growth and combating attacks by fungi.

ALBERT PEYRON, JEAN VERGE, LOUIS BLANCHARD and PIERRE GORET : The genesis of interstitial cells at the expense of seminiferous tissue, in the embryonic testicle and in the seminome.

GEORGES BOURGUIGNON and RENÉ HUMBERT : Double contraction and double chronaxy of normal striated muscle of man and mammals. Analysis by progressive currents.

PHILIPPE L'HÉRITIER : The appearance of differences of pigmentation between various strains of *Drosophila melanogaster*, wild type, as the result of a larval intoxication.

MME. VÉRA DANTCHAKOFF : The effects of a permanent treatment with folliculine on the male organism.

MME. PAULETTE CHAIX : The mechanism of the action on substances containing sulphur in glucose by *Propionibacterium pentosaceum*.

MLLE. CAMILLE CHATAGNON : The gastric secretion of bromine in the course of bromide therapeutics.

GUSTAVE GUITTONNEAU and RENÉ CHEVALIER : The sensibility of the *Azobacter* of the soil to the molecular structure of the monoxybenzoic acids. For the strains of *Azobacter* studied, none of the isomeric sodium hydroxybenzoates was toxic, but their food value depended markedly on the position of the hydroxyl group.

ANDRÉ BOIVIN and MME. LYDIA MESROBEANU : Bacterial variations and complete *O* somatic antigen.

FERNAND ARLOING, ALBERT MOREL, ANDRÉ JOSSERAND and LOUIS PERROT : The stereochemical configuration of the organic basis and the anti-tumoral activity of the metallo-ascorbic complex compounds.

Melbourne

Royal Society of Victoria, November 12.

ELIZABETH A. RIPPER : Stromatoporoids of the Lilydale limestone. (2) Species of *Syringostroma*, *Stromatopora*, *Stromatoporella* and *Idiostroma* are described. A review of the whole fauna indicates that a high proportion of the species can be identified with forms occurring elsewhere in the Middle Devonian ; three occur in the Helderbergian (Lower and lower part of the Middle Devonian) of North America, while only two are typical of the Wenlock limestone of Great Britain and the Niagaran of North America. The Lilydale stromatoporoid fauna has very little in common with that of the British Wenlock with which the Lilydale limestone has generally been compared, and should rather be correlated with European and North American Devonian faunas.

KATHLEEN M. CROOKS : Studies on Australian aquatic Phycomycetes. An account of the systematic and physiological characteristics of twenty species of aquatic fungi collected in the vicinity of Melbourne.

ISOBEL COOKSON : On *Saprolegnia terrestris* n.sp., with some preliminary observations on Victorian soil Saprolegniales. The forms identified from Victorian soils include—*Saprolegnia terrestris* n.sp., *S. megasperma* Coker, *S. anisospora* de Bary, *Isoachlya unispora* Coker and Couch, *Achlya apiculata* de Bary, *A. racemosa* Hilderbrand, *A. caroliniana* Coker, *Thraustotheca clavata* (de Bary) Humphrey.

R. T. PATTON : Ecological studies in Victoria (4). Red box – red stringybark association.

Vienna

Academy of Sciences, October 22.

A. SOMMERFELD : Klein's parameters α, β, γ, δ and their importance to the Dirac theory.

JOSEF A. PRIEBSCH and W. BALDAUF : Temperature effect with cosmic rays (from three years records of the ionization on the Hafelekar, 2,300 m. above sea-level).

MARIETTA BLAU and HERTA WAMBACHER : Distribution of α-tracks of the radium series.

E. MOLES and T. TORAL : The molecular groups CO_2:O_2 and N_2O:O_2.

G. JANTSCH and E. SCHUSTER : Determination of the solubility of mercurous oxalate.

HANS STROUHAL : The terrestrial Isopoda collected by Dr. Franz Werner in Greece and the Ægean Isles.

Forthcoming Events

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

Monday, January 18

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. David Brunt: "Climatic Cycles".

KING'S COLLEGE, LONDON, at 5.30.—Prof. J. G. Semple: "Projective and Abstract Algebraic Geometry" (succeeding lectures on January 25, and February 1, 8, 15 and 22).*

ROYAL SOCIETY OF ARTS, at 8.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays" (Cantor Lectures. Succeeding lectures on January 25 and February 1).

Tuesday, January 19

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. J. C. Drummond: "Problems of Nutrition" (succeeding lectures on January 26 and February 2, 9, 16 and 23).*

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, Piccadilly, W.1).—Dr. David Forsyth: "Heredity versus Environment—a False Issue".*

ROYAL STATISTICAL SOCIETY, at 5.15—(at the Royal Society of Arts).—Major P. Granville Edge: "The Demography of British Colonial Possessions".

ENGINEERS' STUDY GROUP ON ECONOMICS, at 8—(at 23, Grosvenor Place, London, S.W.1).—Major L. Urwick: "The Contribution of Scientific Management to the Solution of Present Economic Difficulties".

Wednesday, January 20

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. R. G. Stapledon: "The Utilization of the Hill Lands of Great Britain to the Best National Advantage" (succeeding lectures on January 21 and 22).*

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—Annual Meeting.

Dr. R. S. Clay: "The Mechanical Development of the Microscope".

INSTITUTION OF CHEMICAL ENGINEERS, at 6—(at the Chemical Society, Burlington House, Piccadilly, London, W.1).—Symposium on "Superphosphate—its History and Manufacture".*

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Annual Meeting.

Dr. A. D. Imms, F.R.S.: "Some Reflections on Recent Developments in Entomology" (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—J. de la Valette: "The Study of Colonial Culture in Holland and France".

INSTITUTE OF CHEMISTRY (LONDON SECTION), at 7.30.—Dr. C. Ainsworth Mitchell: "Some Recent Advances in the Scientific Examination of Documents".

Friday, January 22

ROYAL INSTITUTION, at 9.—Gerald Seligman: "The Nature of Snow".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR INVESTIGATOR FOR CORROSION RESEARCH in the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1 (January 20).

CIVILIAN EDUCATION OFFICER (Grade III, physics or engineering) in the Royal Air Force Educational Service—The Secretary, Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (January 20).

TWO SENIOR SCIENTIFIC OFFICERS in the Explosives Directorate, Research Department, Woolwich, S.E.18—The Chief Superintendent (January 23).

TECHNICAL OFFICERS (electrical engineering) in a War Department establishment at Woolwich—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W1, (January 29).

ASSISTANT DIRECTOR OF HORTICULTURAL EDUCATION to the Norfolk County Council—The Director of Agricultural Education, Agricultural Station Offices, Sprowston, Norwich (January 30).

ASSISTANT BOTANIST in the Plant Breeding Institute, School of Agriculture, Cambridge (January 30).

DIRECTOR OF THE ALL-INDIA INSTITUTE OF HYGIENE AND PUBLIC HEALTH, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (January 30).

DIRECTOR OF POTTERY RESEARCH in the proposed Pottery Research Association at Stoke-on-Trent—Sidney H. Dodd, Piccadilly, Tunstall, Stoke-on-Trent (February 1).

INSTRUCTOR LIEUTENANTS (mathematics, physics, chemistry, engineering) in the Royal Navy—The Director, Education Department, Admiralty, 5 Millbank, London, S.W.1 (February 8).

ASSISTANT METEOROLOGISTS (Grades II and III in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (March 1).

NUFFIELD PROFESSOR OF CLINICAL MEDICINE in the University of Oxford—The Registrar (April 17).

ASSISTANT SURVEYOR OF LANDS in the Civil Engineer-in-Chief's Department, Admiralty, London, S.W.1 (mark envelope "A.S.L.").

LECTURER IN DOMESTIC SCIENCE in the Huguenot University College, Wellington, South Africa—The Office of the High Commissioner for South Africa, South Africa House, Trafalgar Square, London, W.C.2.

Official Publications Received

Great Britain and Ireland

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academical Year 1935–1936. Pp. 123. (Cambridge: Printed at the University Press.) [2412

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport). Annual Report, and Results of Meteorological Observations, for the Year 1935. By Joseph Baxendell. Pp. 32. (Southport: Fernley Observatory; London: Meteorological Office.) [2912

The Royal Botanic Gardens, Kew. Illustrated Guide, 1936. Pp. 64. (London: H.M. Stationery Office.) 1*s.* net. [41

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries: Report for the Year 1935. Pp. 41+2 plates. (London: H.M. Stationery Office.) 9*d.* net. [41

Other Countries

New Zealand: Department of Lands and Survey. Discharged Soldiers Settlement: Report for the Year ended 31st March 1936. Pp. 12. (Wellington: Government Printer.) 6*d.* [2912

The Institute for Science of Labour, Kurasiki, Japan. Annual Report of the Institute for Science of Labour for 1935. Pp. ii+35. (Tokyo: Institute for Science of Labour.) 70 sen. [2912

Government of Madras. Livestock of Southern India. By Capt. R. N. Littlewood. Pp. x+239. (Madras: Government Press.) 4.2 rupees. [2912

The National Geological Survey of China. Palaeontologia Sinica. Series D, Vol. 7, Fasc. 3: The Mandibles of *Sinanthropus pekinensis*; a Comparative Study. By Franz Weidenreich. Pp. 162+15 plates. (Nanking and Peiping: National Geological Survey.) [2912

Osmania University, Hyderabad. Publications of the Nizamiah Observatory. Astrographic Catalogue, 1900·0, Hyderabad Section (Part 3), Dec. + 35° to + 40°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of T. P. Bhaskaran. Vol. 10: Measures of Rectangular Co-Ordinates and Diameters of 64,791 Star-Images on Plates with Centres in Dec. + 38°. Pp. xxv+236. (Begumpet: Nizamiah Observatory.) 15 rupees; 20*s.* net. [2912

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok 15, 1933·iv: Meteorologiska iakttagelser i Sverige, Band 75. Pp. x+107 7.00 kr. vii: Meteorologiska iakttagelser i Riksgränsen. Pp. ii+48 4.00 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [2912

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1932. Pp. 103. (Stockholm: Kungl. Sjökarteverket). [41

Sudan Government. Annual Report of the Agricultural Research Service for the Year ended 31st December 1935 (being Part 2 of the Annual Report of the Department of Agriculture and Forests) relating to Experimental Results obtained in the Season 1934–35. Pp. v+xi+183+14 plates. (Wad Medani: Agricultural Research Service.) [41

India Meteorological Department. Scientific Notes, Vol. 7, No. 70: A Study of Correlation Coefficients of Mean Maximum Temperatures, between Successive Months, at a few Selected Stations in India. By Dr. R. J. Kalamkar. Pp. 15–20+3 plates. (Delhi: Manager of Publications.) 5 annas; 6*d* [41

U.S. Department of Agriculture. Circular No. 412: Groups of Plants valuable for Wildlife Utilization and Erosion Control. By W. L. McAtee. Pp. 12+7 plates. (Washington, D.C.: Government Printing Office.) 5 cents. [41