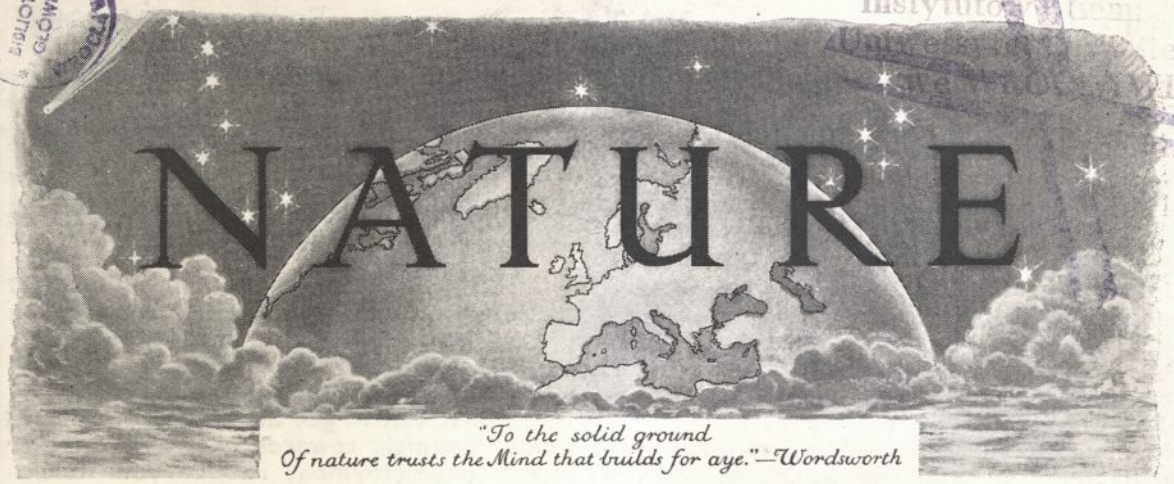

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NATURE

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CO-ORDINATION IN ADMINISTRATION

THE simultaneous issue of the tenth and eleventh reports of the Select Committee on National Expenditure (London : H.M. Stationery Office) has come very appropriately almost exactly a year after the outbreak of war, and provides an occasion for a survey of the progress made in co-ordinating the national effort.

The Select Committee has from the start steadily refused to be limited by any narrow conception of the term economy. Its eleventh report, detailing action taken on the second to eighth of the reports already issued by the Committee, together with the departmental comments on the Committee's recommendations, admirably illustrates the extent to which the Committee has already become a body of well-informed, responsible but disinterested critics of departments concerned with the economic direction of the War. Despite the extensive changes already being made in some directions that are leading directly to greatly increased production, there is a widespread opinion that the pace of our economic effort is by no means rapid enough, that it lacks drive and does not co-ordinate sufficiently for a real war plan the various phases of our economic effort.

These misgivings were not dispelled by Mr. Greenwood's recent review in the House of Commons of economic policy, with its admission that we are still in process of changing from peace to war economy. Although the present Government is not to blame for the deficiency, Mr. Greenwood afforded little evidence that it has really surveyed the consequences to the economic life of the country of a war of two or three more years, or that it is taking sufficiently energetic steps to achieve its objective of "a Britain completely mobilized economically into a public service, devoted to national ends and regardless of selfish interests".

The eleventh report of the Select Committee indeed affords more reassuring evidence of the Government's concern and activity in this field than is provided by Mr. Greenwood's speech. It is clear that the Government has been far from indifferent to this informed criticism. At the same time, there is evidence of undue departmentalism in a number of the comments upon the Committee's proposals, as for example in the Treasury's memorandum on the Contracts Co-ordinating Committee.

It may be remembered that in its second report, the Committee commented on the co-ordination of contract procedure, pointing out defects in the present organization and recommending the appointment of an officer of high standing and experience to act as chairman of the Contracts Co-ordinating Committee to bring order in the principles and practice of contract procedure, with duties including the examination and removal of general difficulties experienced by contracting firms. The Treasury's observations on this point betray the worst failings of departmentalism, for which the Civil Service to-day has been under constant criticism, and indicate a practical refusal to admit the need for co-ordination or the danger of a departmental mind in this matter. The counter-proposals that the functions of the permanent chairman should be limited and that he should be in fact the chairman of the Treasury Inter-Service Committee, are unlikely to be welcomed by the Select Committee.

If this example is far from being typical of Government reaction to the recommendations of the Select Committee on National Expenditure, it does indicate that this informed opinion needs to

be strongly supported outside the ranks of the Committee if we are to obtain the wide vision and the receptivity to new ideas and new methods so essential in the elaboration of a real economic policy. Moreover, the question is closely allied to the whole set of problems known as 'priority', which are examined in the simultaneously issued tenth report of the Committee, on which departmental statements have yet to appear.

The tenth report of the Committee is an acute analysis of a vital part of war-time economic control, and the present priority organization is roughly handled. The name is indeed misleading, as priority, properly speaking, only describes one, and the less urgent, of the two distinct procedures involved. A community at war is faced with a shortage of all the factors of production, but it cannot permit the demand for materials and labour to be accommodated to the supply of them by the normal method of rising prices. It must provide first some mechanism of deliberate rationing and allocation, and then if necessary some system of priority. Allocation determines what shall be made; priority decides what shall be made first.

The report of the Select Committee performs a useful function both for the departments and for the public in keeping these two problems distinct. The elaborate machinery for priority, in the wider and looser sense of the term, which has been in existence since the outbreak of the War, has hitherto been concerned almost entirely with allocation. There was in fact no priority at all until June last, and since then there has been only a general Priority of Production Direction, merely notifying to industry two short lists of very broad categories of munitions most urgently needed.

The report urges, in effect, that this mainly negative conception should be replaced by a coherent system of allocation and priority, determining priority of production right down the chain from the War Cabinet decision to the factory. Only thus can we hope to eliminate the stumbling block which the independent attitude of war departments and competition between them presented in the War of 1914–18, and which in the Select Committee's opinion is developing again to-day. The Committee proposes, accordingly, that the Priority Organization and with it the Raw Materials Department and the Salvage Organization should be separated from the Ministry of Supply and placed under a separate minister, or a parliamentary secretary to the Ministry of Defence.

Whatever form the new organization may take, the sub-committee insists that it must be so constituted that it will command the respect of all departments and possess overriding powers in the field of priority and material comparable to those of the Treasury in the field of finance. These powers should be adequate to compel consuming departments, in cases where future difficulties of supply are foreseen, to modify their specifications or their quantitative requirements in advance of these difficulties. The allocation or rationing of materials would be applied in this centralized manner to every material that is scarce enough to form a bottle-neck in production.

In regard to priority, the Committee makes a further distinction. In the first place, priority directions are required based on detailed planning of the supplies and needs of the War Departments. While rapid changes of policy and so of requirements may be demanded, if factories are to be kept efficiently at maximum production, some limit is essential, and it is recommended that both planning and priority direction periods should be for not less than three months. In addition, however, the Committee recommends that a system of priority grading should be established, by which individual contracts which are delayed or obstructed could be given a specific priority.

The Committee also comments on the need for rapid improvement of the existing organization if the cost of the nation's effort is to be reduced to the minimum compatible with full efficiency. Recommendations are also made for the expansion and unification on an inter-departmental basis of the whole area organization for this purpose, for the appointment of departmental 'area progress officers' with knowledge of local and general production to work as part of the area organization, and for the submission of progress reports simultaneously to the area organizations and the department as well as for the establishment of progress branches in departments to work in close connexion with the principal priority officer and his staff.

The Select Committee in this admirable report has well earned the gratitude of the country for its lucid and scientific analysis of a detailed and laborious but essential aspect of the problem of economic co-ordination. In doing so, it has provided a noteworthy illustration of the way in which democratic institutions can adapt themselves to the demands of totalitarian warfare. It is reassuring to note from a memorandum by the Ministry of Supply included as Appendix 6 in the

eleventh report that action has already been taken in regard to the reconstitution of the area boards and appointment of area progress officers.

It remains to be seen, however, how far the full inter-departmental control required has been established throughout all stages from Cabinet direction to delivery to the user to eliminate competition. The establishment thus of a national, as opposed to a departmental, outlook will ensure full efficiency in our economic effort. Moreover, only such a national outlook is capable of overcoming the numerous obstacles which departmentalism and sectional interests still present to the development of a really adequate economic policy, with all the repercussions this would have on many sides of our national life. If by the whole-hearted support which scientific workers, along with other sections of the community, afford to such informed and impartial criticism and analysis, whether or not it affects their own immediate interests, we can ensure the firm establishment of such a national point of view in handling all problems, we shall assuredly find that we have not only forwarded our immediate war effort, but also implemented the wise and far-sighted handling of the many problems of reconstruction which are so closely interlocked with the prosecution of the present task of national defence.

COPERNICAN LITERATURE

Three Copernican Treatises

The Commentariolus of Copernicus; The Letter against Werner; The Narratio Prima of Rheticus. Translated with Introduction and Notes by Edward Rosen. (Records of Civilization: Sources and Studies, No. 30.) Pp. xi+211. (New York: Columbia University Press; London: Oxford University Press, 1939.) 19*s*. net.

IN the welcome expansion of interest in the history of science, which is now taking a more systematic and recognized form, one feature is the amount of attention devoted to Copernicus. Whether the ultimate effect will be to increase the stature of a rather legendary figure may be doubted, but it is all to the good that the original documents on which a critical judgment must be based should be made available in the English language. It is to be hoped that Mr. Rosen will persevere in his declared project to produce an English translation of the "De revolutionibus". In the meantime, he has given a translation of three treatises, two by the hand of Copernicus himself and the third the well-known account by Rheticus. The main work is all that is needed to complete the sources of information on the doctrines of Copernicus.

The "Commentariolus" is a short sketch of those doctrines written, apparently at an early date, by Copernicus himself. In several details it differs from the system ultimately adopted. But the only features of value, the revival of the ideas of Aristarchus and Heracleides, are clearly stated as explicit assumptions in this treatise, which for three centuries existed only in manuscript form.

The difficulty in accepting the traditional estimate of Copernicus is that apart from the central doctrine he was a complete reactionary. His real reason for taking even this step towards a true system remains, among the various arguments brought forward, far from clear. In the main he followed Ptolemy as closely as possible, and the chief difference is due to the fact that he was more Aristotelian than Ptolemy, and to that extent more in error. For him uniform motion in a circle had the nature of a categorical imperative, and this meant uniformity of motion relative to the centre of the circle. Now just as the eccentric circle represents a true approximation to a planetary orbit of small eccentricity, so uniform angular motion about the equant represents a genuine approximation to the law of areas. It is a most ingenious feature in the Ptolemaic theory; but to Copernicus it presented the most fatal defect because it was contrary to the teaching of Aristotle. This objection seems to have presented the strongest incentive to find an alternative to the Ptolemaic system. It seems to have had more weight than the only argument which was really valid in the circumstances, that from simplicity. The "Commentariolus" ends by assigning thirty-four circles to explain the motion of the planets, including no fewer than seven for Mercury alone.

The real merit of Copernicus was that, in the teeth of contemporary dogma, he attributed to the earth the motions of a rigid body. But this was not all. He not only affirmed the predominance of the sun, but he also asserted that the "eighth sphere", the sphere of the stars, was fixed and that it represented the true frame of reference. He further assigned to this sphere dimensions so vast that the "great circle", or earth's orbit, was insignificant in comparison, thus anticipating the criticism which Tycho Brahe afterwards thought

insuperable. Thus the ecliptic was defined as the plane of the "great circle" and the polar axis and equator by the diurnal motion. There remained to be determined the motion of the polar axis itself, which means variations in the obliquity of the ecliptic and precession. The task was beyond the powers of that age, as it was to produce a satisfactory planetary theory. Copernicus has stated his view frankly :

"The situation is the same with respect to the motion of the eighth sphere. However, by reason of the extreme slowness of this motion, the ancient mathematicians were unable to pass on to us a complete account of it. But if we desire to examine it, we must follow in their footsteps and hold fast to their observations, bequeathed to us like an inheritance. And if anyone on the contrary thinks that the ancients are untrustworthy in this regard, surely the gates of this art are closed to him. Lying before the entrance, he will dream the dreams of the disordered about the motion of the eighth sphere and will receive his deserts for supposing that he must support his own hallucination by defaming the ancients. It is well known that they observed all these phenomena with great care and expert skill. . . ." And so his exaggerated respect for the work of the ancients plunges Copernicus into accepting their fictitious notion of 'trepidation'.

This characteristic passage occurs in the "Letter against Werner", the second document of which a translation is now given. Even Regiomontanus saw that the foundations of astronomy must be laid entirely anew. It is unnecessary to refer in greater detail to the treatise published by John Werner in 1522 at Nuremberg, or to this criticism of it by Copernicus. But it may be noticed that the question is one of the class discussed far more effectively a century later by Horrocks. Horrocks was a greater man than Copernicus, and he could profit by the progress which had been made in the intervening century. It may be that the earliest telescopic observations of position were not greatly superior to the old eye observations at their best, such as those made by Hevelius, for example. But they had the effect of disclosing the fallibility of observations in general and the necessity for careful attention to the conditions in which the observations were made. Confidence in the ancient records was quickly undermined, and astronomy was free to pursue its path unhampered by the dead hand of the past.

The third tract in the present set is the "Narratio Prima" of Rheticus, first published in 1540. This is chiefly familiar because it was added by Maestlin in 1596 to the first edition of Kepler's "Mysterium Cosmographicum", and has been reproduced in later editions of Kepler's works, as a convenient sketch of the Copernican system. The translation is therefore very welcome. The tract is the product of youthful enthusiasm by one who fell completely under the spell of the master. It is marred by one section full of astrological superstition, which may be pure Rheticus. But it still serves its original purpose, which succeeded so well that the sequel implied in the title was rendered unnecessary by the speedy appearance of the "De revolutionibus".

The translations are very freely annotated. The notes are devoted mainly to points of literary scholarship, and will be found valuable. Far less attention has been given to questions of scientific importance with which the text abounds. This is not a matter for complaint. What is wanted at the present stage is a clear version on which scientific discussion can afterwards be based. In the development of the history of science the collaboration of many minds will be needed. Only when the original texts become accessible in a familiar modern language will true scientific appreciation be really possible. The time when Latin could be contemplated as the one scientific medium, as Wallis conceived it in the seventeenth century, is now past. New conditions call for new methods, and here is an excellent sign that they will be forthcoming.

One or two comments may be made. The familiar formula σώζειν τὰ φαινόμενα (*apparentias salvare*) is bound to recur. Because the phrase "to save the appearances" has been used as an equivalent, something mean and unworthy is suggested, as though the article were absent. But surely the meaning is "to satisfy the observations", no more and no less, and in this guise the Greek idea ceases to present anything repugnant to the modern scientific mind.

A phrase of Rheticus "ad similitudinem pendentium in aere", to which parallel expressions occur in the language of Copernicus, leads the translator to comment, "Are we justified in attributing the pendulum to Copernicus ? I think not". But many had seen the hanging lamp at Pisa before Galileo inferred the tautochronous principle, and that lamp was by no means the first pendulum. To reject the comparison of an astronomical libration with the motion of a pendulum is surely an example of gratuitous scepticism, for the figure would be natural and familiar in any age and in itself implies no scientific knowledge of any kind. The pendulum is no man's invention. It repeats an experiment which Nature places daily before men's eyes. The extraordinary thing is that before the days of Galileo no profitable lesson seems to have been drawn from it.

H. C. PLUMMER.

SOUTH AFRICAN BIRDS

The Birds of South Africa

By Dr. Austin Roberts. (Published for the Trustees of the South African Bird Book Fund.) Pp. xxxii+463+56 plates. (London: H. F. and G. Witherby, Ltd.; Johannesburg: Central News Agency, Ltd., 1940.) 30*s*. net.

IN 1867 that versatile naturalist E. L. Layard published a small quarto book on the birds of South Africa, which then consisted of Cape Colony north to the 28th degree parallel south latitude.

In addition to his own personal knowledge and that of his friends, the author relied for information on the works of Le Vaillant and Sir Andrew Smith, who published large, expensive volumes at the end of the eighteenth and beginning of the nineteenth centuries. Some years later Dr. Bowdler Sharpe edited a revised edition of Layard's work and enlarged it to include the whole of the South African sub-region—the country south of the Zambezi and southern border of Angola. Then in 1899 appeared the first volume on birds in the "Fauna of South Africa" by Dr. A. C. Stark, who unfortunately was killed by a shell in Ladysmith in the latter part of that year, and the remaining volumes were completed by Mr. W. L. Sclater. For long this was the standard work on South African birds, but it is now quite out of date and difficult to obtain. The appearance therefore in 1937 of Dr. E. L. Gill's "First Guide to South African Birds" was very welcome, since it placed in the hands of the public a reliable and fully illustrated book at a moderate price. The present volume is on similar lines, covers a larger field and includes all the birds found south of the Zambezi and Cunene Rivers.

General Smuts has written a foreword, and he explains that the publication of the book was made possible by the South African Book Fund started in 1938 for the purpose of publishing works dealing with the ornithology of South Africa. He points out that this work is suitable for use in schools, the general public and the student engaged in studying the great variety of South African bird life. In his introduction the author makes some general remarks on the study of birds followed by a rather lengthy discussion, on the subject of nomenclature and classification, which seems rather outside the scope of the book. The remarks on distribution and variation direct attention to interesting problems in South Africa which still remain unsolved. Dr. Roberts divides South Africa into twenty-one sub-regions and briefly describes the characters of the country, the vegetation and the birds peculiar to each.

As the book is intended as a simple and concise guide, descriptions are in most cases omitted and the coloured plates have to be relied on for identification. These as a whole are good, but frequently lack the characteristic attitudes and are on the small side. The plate of the wading birds, for example, suffers from a similarity in all the figures, and possibly the artist did not know his subjects in the field and was therefore unable to exaggerate the important differences, which is rather necessary in small figures. It is unsatisfactory to attempt to show slight colour differences except by the most expensive reproduction, and Dr. Roberts has wisely supplemented some of the figures with brief descriptions. He believes in the multiplication of genera, and in some cases it is difficult to recognize species under the generic name used—for example, Spipola for the common tree pipit—but in every case the more generally accepted generic name is given as a synonym. In addition there are English, Afrikaans as well as native names, and a separate index for each at the end of the book—very convenient but rather extravagant as regards space.

The letterpress is of necessity concise, but Dr. Roberts has done it in an admirable manner and has something to say of the status, distribution, habits and nesting of each bird. We wish it had been possible to have included a few lines on field identification, which would be very helpful to beginners, and no one could have done it better than the author with his life-long experience in the field.

South Africa has a very varied bird fauna ranging in size from the ostrich to the penduline tits and sunbirds. Of the first mentioned we learn that the experiment of crossing the North African race with that farmed at the Cape to improve the feathers was never completed, owing to the demand for feathers ceasing with the advent of the motor-car! Only one species of penguin—the jackass—is endemic, but the rockhopper of the Antarctic seas is occasionally driven north on to the southern coast. Anyone who has been fortunate to make a voyage around the Cape must have noticed the numbers of albatrosses and petrels met with, and as many as thirty-two kinds are listed as occurring in these seas. The white stork migrates to Africa for the winter, and should there be plagues of locusts or caterpillars in the Union large flocks make their appearance and do useful work in destroying them. A few occasionally remain

behind after the main body has migrated north ; but they do not breed and are probably sickly birds.

A characteristic bird of the savanna veld is the secretary bird, which stalks gracefully about in search of snakes and other prey. It nests in low trees and the young do not leave the nest until they can fly. Dr. Roberts considers this an unusual habit for a terrestrial bird and suggests that it has come about because the young have very brittle legs ! But surely the young of all birds, terrestrial or otherwise, which nest off the ground do not leave the nest before they can fly, except in the case of ducks. There is a long list of birds of prey and in spite of the opening up of the country the numbers of vultures have not greatly diminished, except in one or two cases. The same, however, cannot be said of the larger eagles which, owing to their depredations on farm stock, have been sadly reduced, though still common in the remoter areas. Many different kinds of francolins inhabit South Africa and show interesting geographical colour variation, while the Union might be described as the headquarters of the bustards, since no fewer than eleven species occur within the area, including that fine bird the kori or giant bustard, the gom-pou of the Dutch. Hornbills are well represented and one of the most interesting is the southern ground hornbill. Unlike other species it is to a great extent terrestrial, lays its eggs in a hollow in a tree, and makes no attempt to wall up the female on the nest ; indeed the male assists in the incubation. It is found both on the veld and forested area and has similar feeding habits to the secretary bird, but moves about on the ground with waddling walk. These birds utter a booming call which the natives interpret as the female saying "I'm going, I'm going, I'm going home to my relations," the male replying, "You can go, you can go, you can go home to your relations !"

Three species of the well-known honey guides are found in the Union. These birds are unique in that they enlist the help of man to assist them in obtaining honey, while they call on other birds —barbets, woodpeckers and bee eaters—to hatch their eggs and rear their young !

The common cuckoo reaches South Africa in winter and so does the greater spotted cuckoo which in the northern nesting season is found from Spain to Persia. It also breeds in our winter in South Africa and lays in the nests of starlings, but as others are known to breed in the tropics, both north and south of the equator, there is probably more than one race and each migratory. Among the various other cuckoos are the beautiful emerald and bronze species, which are also migratory. The colies belong to a family unknown outside Africa and three different kinds are found in the south. From their habit of creeping about in trees and bushes in search of fruit and berries they are known as mouse birds.

The Eurylaimidæ or broadbills is a typical oriental family which extends into Africa, where it is represented by four species, one occurring in the south. In like manner the Pittidæ or ant thrushes are also eastern, but only two species have reached Africa and one which is migratory occasionally strays within the northern parts of the Union. The common swallow is a very numerous visitor to South Africa and the house martin as well, but in smaller numbers. The latter is said to breed there, but Dr. Roberts thinks further investigation is necessary. Curiously enough the winter quarters are still unknown of two of the common breeding species—the larger striped swallow, *Hirundo cucullata*, and the South African cliff swallow, *Petrochelidon spilodera*. The creepers are essentially a Palæarctic family, but an aberrant species, the spotted creeper, *Salpornis spilonota*, occurs in the plains of northern India and ranges from there through southern Abyssinia, the Sudan to Nigeria and south to Southern Rhodesia and Mashonaland.

The Promeropidæ or sugar-birds is the only family peculiar to South Africa and consists of only two species ; one, *P. cafer*, is found in the Cape Province, while the other, *P. gurneyi*, is known from Natal and the country northward to Southern Rhodesia. These birds have a remarkable habit of performing an aerial dance over the protea trees when they are in blossom. The relationship of the family is uncertain but the nesting and feeding habits are not unlike those of sunbirds. Among the large family of warblers—Sylvidæ—Dr. Roberts mentions no less than nine species that breed in Europe and have been recorded from the Union at other seasons. Included in the family is the genus Apalis, which consists of four very variable species divisable into fourteen races. Then there are the fan-tailed warblers or cisticolas, recently monographed by Admiral Lynes. We notice that there is some difference of opinion between Dr. Roberts and Admiral Lynes as to which birds are to be considered species and which sub-species.

The last family is called by Dr. Roberts the Ploceidæ and this he divides into a number of subfamilies including the Fringillinæ—the true finches and buntings—considered by most authors a separate family. But surely in any event the name of the family must be Fringillidæ. Be that as it may, the family as now constituted contains a number of very interesting birds. There is that remarkable sociable weaver, which builds a very large communal nest occupying the whole of an isolated tree and inhabited by scores of pairs. Other species breed also in colonies, but construct

retort-shaped nests, others again build round balls of grass supported on grass stems, while a few make their nests on the ground. In contradistinction to this variation in nest building one sub-family, the Viduinæ or widow birds, make no nest but lay their eggs in those of small members of the family. Among the true finches there is the Cape canary, *Serinus canicollis*, and a dozen or so others including the chaffinch now established in the Cape Peninsula. Among the buntings are three species of that widely distributed genus Fringillaria, or rock buntings, ranging from western India to the Cape.

This will prove a very useful work not only for the inhabitants of the Union but also to ornithologists throughout the world. It is much to be regretted that the size of the book had to be limited, and we trust that in the future Dr. Roberts will give us a history of the birds of South Africa.

N. B. KINNEAR.

PRINCIPLES OF MODERN BUILDING

(1) Building Design and Construction
With Reference to the New L.C.C. Regulations. By Felix James Samuely and Conrad Wilson Hamann. Vol. 1. Pp. xi + 350. (London : Chapman and Hall, Ltd., 1939.) 25*s*. net.

(2) The Essentials of Reinforced Concrete Design
A Simplified Text-Book with Special Reference to both Old and New L.C.C. Regulations, and to the Code of Practice of the Building Research Board. By R. F. B. Grundy. Pp. xi + 134. (London : Chapman and Hall, Ltd., 1939.) 10*s*. 6*d*. net.

THE progress of research in all branches of the building industry has inevitably led to the development of new ideas in both design and construction, and to important modifications in recognized methods. In a report published in October 1938 on behalf of the Department of Scientific and Industrial Research ("Principles of Modern Building", vol. 1, Walls, Partitions and Chimneys) it was explained by Dr. R. E. Stradling, then director of building research, in a foreword, that the aim in preparing it was to set out a statement of principles to guide the practical man in adapting his designs to the changes which have been taking place. For about eighteen years, the Building Research Station has been investigating materials and methods and collecting data. Scientific developments, increasing experience and new trends in architecture have led to the codification of new rules, and there are now available for the guidance of designers and constructors the code of practice prepared by the Building Research Board and the new regulations of the London County Council.

Such a position makes necessary the provision of new text-books and hand-books on the branches of the building industry which are affected. Both the volumes referred to at the head of this notice take the new regulations as their basis. Indeed, the first mentioned may be said to have actually arisen out of them.

(1) The authors, finding it necessary to prepare a new set of explanatory notes, tables and sketches for use in the drawing office to meet the requirements of the authorities, took the public-spirited step of making them generally available.

In this, the first of the three volumes in question, the greater part is devoted to technical explanations of the by-laws, accompanied by sketches, tables, specifications and graphs. A section has been given to a short résumé of the enactments to which buildings in London must conform, and the final portion contains an important chapter on monolithy. Here the aim is to explain the monolithic action of continuous framework, so that the designer may be enabled to estimate stresses with sufficient accuracy to ensure that the material is satisfactorily distributed and the factor of safety is constant, or at least approximately so. The tables which are provided enable the work to be carried out expeditiously.

(2) It is on a more modest scale that the subject of the second book is presented, and it is intended more particularly to meet the requirements of those engaged in the design of the simpler types of reinforced concrete structures. By reason of its concise and practical method of presentation and the side-by-side development of theory and practice, it should also prove a text-book of real value to the student. The most important feature of a book of instruction is that it should give its reader a thorough and reliable grounding in its subject. In the case of such elementary problems as arise in columns, slabs, T-beams, retaining walls and foundations, it provides that measure of practical guidance that is most desired by the student or junior designer.

EMBRYOLOGICAL HISTORY

The Rise of Embryology

By Prof. Arthur William Meyer. Pp. xv+367+58 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 34*s*. 6*d*. net.

THIS book by the emeritus professor of anatomy at Stanford University is probably the most complete work on the history of embryology which has yet been produced. It deals both with the discovery of facts and with the growth of ideas, and what adds to its value is the free use that the author has made of the writings of early scholars and naturalists, who thus speak for themselves on the subjects which they investigated or discussed. To the modern student the authors of most of these works are often mere names and their writings are either inaccessible or difficult to obtain. The present work, however, by the liberal use of quotations, enables the embryologist to obtain first-hand information as to what the earlier writers really said and thought and thus to correct common misconceptions as to the value of successive contributions to the study of generation and development. Moreover, by reading these extracts one is made to appreciate something of the zeal and enthusiasm which these early investigators displayed in their studies of natural processes.

Prof. Meyer's volume covers much of the same ground as the smaller work by Dr. Joseph Needham entitled "The History of Embryology", but whereas Dr. Needham's account stops short at 1814 (the year of the publication of John's "Chemische Tabellen des Tierreichs"), in the present treatise the growth of some of the fundamental ideas is traced right down to the adoption of the modern points of view. Thus, it contains a chapter on the growth of morphology, including the discoveries and views of von Baer, a subject omitted from Dr. Needham's book, which was primarily an introduction to chemical embryology. Moreover, a good deal of space is devoted to the fertilization of the ovum, a study which strictly speaking is physiological rather than embryological.

The first chapter is upon the manner in which primitive man in all ages has been wont to regard the role of the sexes in generation, and it is shown that the relation between coition and conception is denied, or at any rate not realized, by some savages even at the present day. There follows a chapter on early historic ideas of generation. Here it is stated that among civilized people the dependence of procreation upon the testicles and ovaries was known in the earliest times. Not only was Aristotle aware of the effects of castration, as carried out upon cockerels, and of spaying as practised upon sows, but the same facts were known to the Chinese, who castrated boars and cocks and spayed sows for economic reasons so early as 1100 B.C. The third chapter deals with spontaneous generation, and contains a readable account of a controversy which ended with Pasteur's discoveries in 1861, although Bastian made an unsuccessful attempt to revive it some ten years later. It was quite natural that all earlier peoples should have accepted spontaneous generation upon the evidence available, but the question now is chiefly of historical interest.

The time-honoured controversy between the upholders of preformation and those of epigenesis occupies the next two chapters. The theory of preformation in its crude form has long been realized to be absurd, and it is merely a matter of amusement to read how certain philosophers estimated the number of miniature beings that should have been contained in the ovary of Eve at the Creation, and then attempted to calculate the time when an ovum or a spermatozoon would be finally depleted and the human race become extinct. The doctrine received apparent support in later times from the morphological investigations of distinguished men of science such as Malpighi, Swammerdam, Réaumur and Haller, and was not finally rejected until the discovery of the mammalian ovum and the contemporaneous researches of von Pander and von Baer. Nevertheless, it may be doubted whether in the light of modern concepts concerning the nature of matter and energy, and (within biology) the part played by organizers in development, the two views are really so fundamentally antagonistic as is usually supposed.

Following upon two chapters on exploded theories such as pangenesis and panspermia, there are entertaining accounts of the search for the mammalian ovum and the discovery, origin and meaning of the spermatozoon, and we read how many false trails were followed before the truth was reached. The following sections upon the evolution of ideas concerning fertilization, the nature of mules, and the formation of monsters contain much to interest the biological historian. Students of the development of biological technique

will extract enjoyment from the chapter on early visual and other aids to investigation. In the final chapter the author shows that he fully realizes that Roux was not the founder of experimental embryology, since Harvey, Malpighi, Redi, Réaumur, Spallanzani and some others carried out experiments within this field in the seventeenth and eighteenth centuries. The more important of these and their bearing on the growth of embryology are herein described and discussed.

The book is well illustrated both by portraits of early biologists and scholars and by reproductions of illustrations from their works.

F. H. A. MARSHALL.

PUYALLUP-NASQUALLY

The Puyallup-Nasqually

By Marian W. Smith. (Columbia University Contributions to Anthropology, Vol. 32.) Pp. xii + 336 + 7 plates. (New York: Columbia University Press; London: Oxford University Press, 1940.) 33*s*. 6*d*. net.

THE Puyallup-Nasqually, who are the subject of Miss Smith's ethnographic study, are coast Salish of southern Puget Sound in the State of Washington on the north-west coast of America. Their habitat affords a striking example of the manner in which the geographical factor may enter into and condition social, political and economic development. The section of low land known as the Puget Sound area is one great watershed honeycombed by creeks and rivers, of which the Puyallup and Nasqually are two whose banks were formerly occupied by the people here under investigation.

Between the peoples of the river-valleys which run down the side of the mountain ranges there was little opportunity for inter-valley communication until the highlands were reached. Within the valleys the people lived in discrete village groups without any political bond whatsoever. The sole unitary concept was geographical. The river furnished the staple of subsistence, the salmon, and owing to the density of the vegetation in former days it afforded the only line of communication, mainly by canoe. Hence while the common occupation of the river-valley fostered a certain sense of unity, it was of insufficient strength to override the lack of common interests. There was no ownership of land even to the limited extent of hunting rights; and the basis of approach between communities or between individuals within the communities was "suspicion", which the ties of kinship only alleviated but did not remove. The social unit was the family living in a communal house containing four to six family groups. One such house, or sometimes two, constituted the village, sedentary in winter, and in spring, summer and autumn the centre from which excursions were made, never far afield, for hunting, fishing and gathering shell-fish.

Miss Smith's data were gathered in the field in 1935–36. By this time the Puyallup-Nasqually culture had gone; except for a small group living on the Nasqually reservation, the people now own their own homes and are scattered among rural and urban white, from whom they can scarcely be distinguished. The author, however, was fortunate in finding a number of aged informants, in whose lifetime the traditional culture had passed away. With the information elicited from these survivors she has been able to put together an arresting and detailed reconstruction of an illuminating example of the culture of the north-west coast.

When so much that is instructive in the light it throws on the economy of a primitive community has been rescued from oblivion with meticulous attention to the record of detail, it may seem invidious to select. It is worth while, however, to direct attention to the part played by prestige based upon wealth—a prestige in which the shaman as such does not share—in determining social status; the high degree of specialization in occupations demanding an individual technique and the development of skill, producing, among others, the professional shaman and the warrior or 'brave'; and the interpretation of every attribute of the individual in the light of religion, in which each individual characteristic was explained by a relationship with a supernatural 'power', which was very like a partnership—in fact, the relationship already more familiar to students of the North-West culture as that with the 'spirit-helper', or less correctly, as it was formerly put, 'individual totem'.

Miss Smith's inquiries have effectively covered every aspect of native life, economic and social, as well as material culture in the area of her investigation so far as these can now be recovered. Her account is a valuable contribution toward understanding of the North-West culture as a whole, which for so long has provided the anthropologist with a profitable and fascinating field for inquiry.

Sepia

By Dr. David H. Tompsett. (L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 32.) Pp. 184+25 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1939.) 12*s.* 6*d.*

THE new L.M.B.C. Memoir on the cuttlefish *Sepia officinalis* well maintains the tradition of a famous series, and it is assured of an especially warm welcome in that it fills a long-felt gap in the descriptive literature of type species. At last between two covers we have a reasonably detailed account of this magnificent invertebrate. The memoir follows the usual plan of the series, taking system by system with careful instructions for their dissection. An especially pleasing feature is the photographic reproduction of the original drawing made by Bell in 1787 from Hunter's injection of the circulatory and respiratory organs. The student will be grateful for the hypothetical primitive mollusc and for the adaptations from Naef to illustrate the evolution of the cephalopod shell. An appendix gives useful directions for preservation and injection.

The eighty-one illustrations comprising the plates are fully adequate for their purpose, although occasionally the shading is not altogether happy, in that it fails to give a convincing appearance of solidity. One would have liked a carefully drawn stereogram of the coelomic cavities imagined dissected and viewed from the side. Only one who, like Dr. Tompsett, has soaked his mind in the spatial relations of the parts could draw such a figure. It would have been constantly helpful to all who study Sepia, as indeed will be this memoir as it stands.

The Pinpoint Planetarium

By Armand N. Spitz. Pp. vi+86+24 charts. (New York: Henry Holt and Co., 1940.) 2 dollars.

THE existence of planetaria in several American cities has assisted in arousing interest in astronomy; but, as the author of this work points out, a planetarium lecture lasts only an hour and few people are able to attend regular lectures. The Pinpoint Planetarium has been designed for those who wish to commence the study of the stars, and, while making no pretence to completion or perfection, it is an initial step which renders it easier to proceed to more serious study.

The book presents two charts for each month, one showing the stars as the observer looks north, and the other the stars when facing south. Very clear directions are given about the method of cutting out the charts and bending them so that a dome is formed. By punching a hole wherever there is a dot, representing a star, and making each hole the size of the dot, the stars appear in their proper relative brightness. By holding the pinpoint planetarium up to the light of a window or lamp, the stars will appear as they are seen in the sky, bright points of light against a dark background.

A chapter is devoted to an explanation of the stars for each month and of the stories that the constellations illustrate. The planetarium does not show the planets, but in a chapter, "Some Sky Lights", rough positions of the planets are given for each month from 1940 to 1945. A glossary-index with the pronunciation of the names of the principal stars and of the constellations is a helpful addition to this useful production.

(1) The Photographic Process

By Prof. Julian Ellis Mack and Prof. Miles J. Martin. Pp. xvii+586. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 33*s.*

(2) The Photographer Speaks

By F. J. Mortimer, Dr. Olaf Bloch, J. Dixon Scott, J. E. Saunders, Marcus Adams, W. L. F. Wastell, Bernard Alfieri, Noel Griggs, H. N. Blinkhorn, Dr. D. A. Spencer. Edited by Dr. Olaf Bloch. Pp. 112+25 plates. (London: George Allen and Unwin, Ltd., 1940.) 7*s.* 6*d.* net.

(1) PROF. MACK and Prof. Martin are to be congratulated on producing for the first time a real text-book of theoretical and practical photography. It is unfortunate that, in Great Britain, photography is not taught but picked up, while it seems that in the United States it is taught to students who have not the necessary knowledge of physics and chemistry. Being produced in the United States, therefore, the book is very detailed, though with some loss of emphasis on fundamentals. It is not a book to sit down and read, but it will be of the greatest value to anyone who teaches the subject and as a reference book for libraries. The manual of practical exercises at the end increases its value. It is profusely illustrated and well indexed. For its contents, it is reasonably priced.

(2) The second book consists of a series of talks on the radio by distinguished photographers. They fail to do justice to themselves, and the additional illustrations do nothing to improve matters. The book cannot be recommended to any type of photographer and does, in fact, a considerable disservice to photography. A. S. C. LAWRENCE.

How to See Nature

By Frances Pitt. (Home-Front Handbooks.) Pp. viii+88+23 plates. (London: B. T. Batsford, Ltd., 1940.) 3*s.* 6*d.* net.

MISS PITT has designed this book especially for evacuees; her love and knowledge of the countryside is convincingly established, and should do much to encourage the beginner in natural history. The facts assembled, however, are presented rather as a series of snippets and afterthoughts which, while highly informative, would have been more useful to beginners if they had been set out in a more orderly array, and if greater attention had been paid to the rules of grammatical orthodoxy. Many of the plant and animal species are grouped together without regard to their abundance or rareness, which might lead to considerable difficulties for new inquirers into natural history lore. The book would be suitable for readers already possessing more than a passing acquaintance with events and happenings in Nature; perusal of the forty delightful photographs would do much to increase their appreciation. T. H. H.

SIR J. J. THOMSON, O.M., F.R.S.

READERS of NATURE will have learned with regret of the death on August 30 of Sir J. J. Thomson, Master of Trinity College, Cambridge, and professor of physics in the University. To those, and they are many, who have the honour of calling themselves his pupils, and to members of the College over which he presided, the news has brought a very personal sorrow. A man of rare intellectual gifts, and great personality, he was the acknowledged leader in the formative which laid the foundations of modern physics.

Born near Manchester on December 18, 1856, Joseph John Thomson was educated first at Owens College, Manchester. He entered Trinity College, Cambridge, in 1876 and was second wrangler, and Smith's prizeman in 1880, the senior wrangler in that year being Sir Joseph Larmor. Four years later, on the retirement of the late Lord Rayleigh, he was elected to the Cavendish professorship of experimental physics at the early age of twenty-seven, a post which he was destined to fill with great distinction for thirty-four years.

It was not unnatural that the early days of his professorship should have been occupied in consolidating and extending the electromagnetic theories of his great predecessor Clerk Maxwell. His investigations, however, convinced him that further elucidation of the relations between matter and electricity could only come from experimental investigations, and that the solution was probably to be sought in a close study of the phenomena which accompany the passage of electricity through gases at low pressure. In a brilliant series of experimental investigations, Thomson succeeded in showing that the cathode rays which stream from the negative electrode in such a discharge are charged particles, and further, by means of his 'electromagnetic balance' to measure not only their velocity, but also the ratio between the mass of the particles and the electric charge which they carry. This turned out to be only about one two thousandth of that for a hydrogen atom. A more fundamental unit than the hydrogen atom thus stood revealed—possibly, as Thomson surmised, an atom of pure electricity. The first public announcement of the discovery of the 'electron' was made by Thomson on April 30, 1897, at a Friday evening discourse at the Royal Institution.

The advent of the electron opened up a wide field for speculation and investigation, of which Thomson took full advantage. In particular, the experimental study of the fundamental structure of matter became an immediate possibility, and much of Thomson's thought and work were directed into that channel. The fame of Thomson's discoveries attracted many workers to the Cavendish Laboratory with whom he freely shared his ideas, and whose labours then, and afterwards, laid the foundations of many branches of modern physics. Thermionics, photo-electricity, and radioactivity sprang into being, and new light was thrown on many of the older branches of physics. This period of activity only died down with the advent of the War of 1914–18.

Thomson became president of the Royal Society in 1915, and in that capacity was largely responsible for the organization of the scientific war effort of the country. He afterwards played an important part in the formation of the Department of Scientific and Industrial Research. In 1918, on his appointment as Master of Trinity College, Cambridge, he resigned his Cavendish professorship. He was, however, immediately appointed to an honorary professorship by the University, and was able to continue in the Cavendish Laboratory those researches which had been the main preoccupation of his life.

It is impossible in a brief memoir even to summarize Thomson's many contributions to knowledge, or the still greater number which he directly inspired. Thomson was more than a great experimental scientist; he was a great teacher, and a great personality. The fame of his discoveries attracted to him a steady stream of young men from every part of the civilized world; but it was his personality which held them. He shared with them freely all that he had of inspiration and ideas; and together with Lady Thomson extended to them a gracious hospitality which lingers as a sweet fragrance in the memory. They responded with an admiration and affection deep and sincere. To them he was always "J. J.", and there was no one like him. It was Thomson's conviction that a university laboratory should not be a factory for turning out 'publications' but a training school for men. The student was there to learn his job by the slow and sometimes painful process of trial and error, and no haste for 'results' was allowed to short-circuit the process. If, as a result, the actual output of 'publications' from the laboratory was somewhat less than might have been expected, a stream of highly trained physicists went out from it, year by year, to carry

on in many lands and in diverse positions the Cavendish tradition.

It was Thomson's lot to receive most of the honours and awards which can fall to a man of science. He was appointed professor of natural philosophy in the Royal Institution in 1905, and was awarded the Nobel prize in 1906. He was knighted in 1908. Universities and academies at home and abroad vied with each other to pay him homage. Each new honour was duly celebrated by his delighted students, but no honour could spoil or change him. To him the joy of discovery was ever its own complete reward.

Thomson lived long enough to see his great discoveries firmly incorporated in the very foundations of modern physics, to be recounted wherever physics is taught. He rests, as was meet and proper, in Westminster Abbey, but he still lives in the grateful memories of the many men whom he taught and inspired. J. A. CROWTHER.

WHEN J. J. Thomson was appointed to the Cavendish chair of experimental physics in 1884, there was no little comment on the youthfulness of the new professor. It was, however, quite consistent with the fresh outlook on scientific research which was then prevalent, particularly at Cambridge. No one could be more fitly entrusted with the continuance of the work which had been begun by Maxwell, Rayleigh and others, and was now given a dwelling place at the Cavendish Laboratory. The man who could write a brilliant piece of mathematical analysis on the motion of vortex rings, and could link together mathematics, physics and chemistry in his daring book of 1886 was just the right man to give vigour to a new enterprise. Under his leadership and inspiration the Cavendish grew rapidly in efficiency and fame. His work was an illustration in full of the principle which he stated in 1893 in the preface to his "Recent Researches": "analysis works to the best advantage when employed in developing the suggestions made by other and more physical methods". At this time he had already begun to concentrate his inquiries on the phenomena attending the passage of electricity through gases; in "Recent Researches" he refers to the importance which Maxwell had already attached to the subject. Thomson's researches were conspicuously successful, and drew an increasing number of workers to a laboratory where inspiration and opportunity were so fortunately combined.

Surely there never was such a brilliant set of young research workers as in the Cavendish Laboratory in the nineties of the last century. Basing their work on Thomson's pioneering, and acting in close collaboration they explored new fields of research, to which Thomson's work on the ion and the electron led them. Rutherford was, of course, a member of that group, and his discovery of the principal properties of radioactivity must be associated with its labours.

Thomson was a powerful thinker, a fine experimenter, and an excellent expositor. His work will always be an international possession as well as a subject of national pride, and this will be not only because of the man himself, great individual though he was, but also because he opened the way for so many other of the great enterprises of modern science. W. H. BRAGG.

IT always seemed to me that Thomson's outstanding personal characteristic was a complete absence of pedantry. He carried a great weight of abstruse learning, but it was never intruded, and if a simple common-sense point of view was attainable, he always preferred it. His comments on things and people were simple and to the point, and although he had his likes and dislikes, he did not in the long run overlook merit wherever it was to be found.

Looking back on the career of his pupils, it may be fairly said that his judgments have been confirmed by events. He was always willing to let his pupils argue with him, and although he had an almost feminine love of having the last word, it was generally found that if anything really to the point had been said, he had tacitly adopted it a day or two later. I believe he will be held in affectionate memory by all who came in contact with him. RAYLEIGH.

J. J. Thomson was elected Cavendish professor in 1884 and I went into residence at Trinity College in 1886. Thus I am one of the few survivors who attended his lectures in those early days. I propose therefore to leave to others, better qualified than I am, the discussion of Thomson's epoch-making discoveries, and the history of the school of electrical and atomic physics formed by the many research students who, in later years, followed his lead into those fruitful fields of experiment. I wish instead to give some impressions of Thomson as a teacher, not in his own special line of work, but in the more general physics suited to the needs of an ordinary undergraduate.

I went to Cambridge with the intention of "reading science", but with only a very elementary knowledge of physics and chemistry, and a vague idea of what was to follow. If I had been asked, I suppose I should have named chemistry as

my probable chief subject of study. But Thomson's lectures on properties of matter and electricity and magnetism opened to me an entirely new realm of thought. It is difficult to express the effect they made on a youthful mind with little knowledge but keen to learn. Thomson was not only a great physicist, but also a brilliant teacher, who could instil enthusiasm not only into those doing research, but also into more elementary students who went to him to learn some physics. So far as I am concerned, it was Thomson's lectures that made me turn unhesitatingly to physics as my chief subject of study. Though I owe much to others also, yet if at any time in an intellectually wandering life I could call myself a physicist, it was due to the teaching of J. J. Thomson.

W. C. D. DAMPIER.

ALTHOUGH all my life I have cherished the greatest admiration for the great physicist whose death the scientific world is mourning, my personal contact with Sir Joseph Thomson was almost confined to the one period, nearly forty years ago, in 1903–4, when I was working in the late Sir William Ramsay's laboratory in London. But to me it was a notable one, and it left the same enduring impression, felt and retained by all the youthful researchers then invading his laboratory at Cambridge, or indeed who have ever been his students, that "J. J." was on the side of the angels, meaning ourselves.

He had invited me to give a few lectures at the Cavendish Laboratory on the chemical aspects of radioactivity, and, horrible to relate, attended them himself as faithfully as the most conscientious first-year undergraduate. My embarrassment may be imagined, as it was quite impossible intelligibly to divorce the chemical from the physical aspect of the subject which he himself had so brilliantly established, and I was just about as comfortable as a classical lecturer would be if Homer had dropped in to hear about the Iliad. To what exactly I owed the unexpected honour I may never know, but it may be that the precipitation of thorium by ammonia was then almost as cryptic to a physicist as the deviation of the electron by combined electrostatic and electromagnetic fields was to a chemist. At any rate, I remember someone told me to illustrate as many as possible of the chemical operations on the lecture table, and that being done everyone seemed happy, and certainly the great man himself showed no inkling of the incongruity of the position.

At that time, and traces may still survive, I was somewhat sceptical about the electrical theory of matter; but as a sceptic it is a pleasure to recognize, as I hope I have done adequately in my popular writings, that from the chemical point of view the really fruitful idea which seems destined to survive, the idea of successive rings or shells of electrons in the atom, only the outer of which were chemically operative, dates from the earlier work of Sir J. J. Thomson and his model atom, rather than from the later ones incorporating it, and will always be a landmark in the history of chemistry. There may not be much in this field that will ultimately survive the test of time; but of this feature of model atoms I think we can already be reasonably sure.

FREDERICK SODDY.

Dr. F. W. Aston, in his graceful tribute in *The Times* of September 4, has, I think, recalled for all the research students of Sir J. J. Thomson what must have seemed to them one of the most striking and yet paradoxical aspects of their Professor's genius. "J. J.", though quite innocent of manipulative skill (witness the way Everett, his devoted assistant, used to shield his elegantly blown glasswork from even his master's caress) was, to my mind, unique in his ability to conceive some new experimental method or some way of overcoming practical difficulties. It was not that "J. J." despised the hard way of the manipulator since, for example, he usually advised his students to take a course of glass-blowing under Everett. I took this course myself, and I am sure I profited by it, but I always felt afterwards that its chief advantage was that one thereby made friends with Everett and, incidentally, gained an even greater appreciation of his own skill.

In my time, as a research student, just immediately before and after the War of 1914–18, the famous daily tea parties in the Cavendish Laboratory were still being held. The tea was made by Roff, who could claim a longer association with the Laboratory than the Professor himself, while the biscuits we understood were of exactly the same variety as had been provided in Maxwell's day. Here the gathering was usually international and the talk only rarely of physics. The Professor displayed a wide knowledge of the countries whence his oversea students had come and could usually draw them out in conversation by shrewdly informed questions.

When a scientific paper was in draft it was possible, by missing one's lunch, to engage the Professor's whole attention. Then he would work carefully through the draft, line by line, checking one's mathematics by alternative methods and generally making most valuable suggestions for simplifications and alterations of presentation, for, as he once pointed out to me, the writer of a paper

is usually soaked in the subject, but the same cannot be said of all his readers. My own subject was not that in which "J. J." was specially interested, but the great depth and breadth of his knowledge of classical physics led him often to suggest for my use most illuminating analogies of experimental and mathematical treatment.

As an undergraduate, working for the Tripos, I had the privilege of listening to those stimulating lectures he gave under the title "The Electrical Theory of Matter". These were far removed in style and structure from the usual formal lecture. The subject of his discussion might be that specially engaging his interest at the time or it might be the subject-matter of some paper, published here or abroad, which he felt was important. His lecture notes, I remember, were usually set out on a scrap of paper or on the back of an envelope. The theoretical treatment was rarely other than original, and was usually worked out as a miniature research starting from first principles. I treasure my own notes of those lectures to this day.

At Cambridge dinners "J. J." usually astonished his colleagues by his wide knowledge of men and affairs. Whether the topic were the cricket history of the northern (English) counties, or athletic records or Victorian novels, he was an amazingly accurate authority. Like most other Masters of Trinity his name will, I imagine, be associated with some *bon mot*. Personally I heard many such fall from his lips; but I think the one which posterity will perhaps choose is his remark on the occasion of the meeting of the electors to some fellowship or research scholarship. Someone had been stressing the claims of a particular candidate, and after a longish eulogium sought to clinch matters by saying that when this particular candidate had written on a subject the last word had been said. "But", interposed the Master "perhaps we're looking for someone who says the first word".

In his speeches at Cavendish dinners "J. J." always stressed the value he set on friendships made in the Laboratory. Certainly there is something unique about the relationship between the professor and the student who sets out on his research career under him. For "J. J." the affairs of his own research students, both during and after their working period with him, were always matters of intimate concern. For the student, respect soon became blended with affection, which ripened as the years went on.

J. J. Thomson made the Cavendish Laboratory the world's focus of experimental physics in his time. Workers from all over the world came to listen to and learn from him. His personal contributions to his subject are unsurpassed, but he would, I imagine, wish his monument to be the loyal affection he inspired in the hearts of that happy band of workers who called him "the Professor" and who were called by him "my research students".

E. V. APPLETON.

IN trying to assess the influence of J. J. Thomson upon the development of physics in Great Britain, two things stand out. The first of these was the completeness with which the important physics posts in the universities of this country and the dominions (and many abroad as well) in Government service, and in industry were filled by men whom he had trained. The record of research students working in the Cavendish Laboratory illustrates this in a striking way. The group of seven students in 1897 includes C. T. R. Wilson, J. S. Townsend and E. Rutherford. To select some names from the years which follow, there are McClelland, Langevin, Zeleny, R. S. Willows, H. A. Wilson, McLennan, R. J. Strutt (Lord Rayleigh), Barkla, O. W. Richardson, Horton, N. R. Campbell, Duane, Bumpstead, Laby, Kaye, Crowther, Vegard, G. I. Taylor, Thirkill, Whiddington, C. S. Wright, Aston, W. Wilson, E. A. Owen, T. L. Eckersley, Andrade, Norman Shaw, James, Appleton. The last pre-War group in 1914 includes his son, G. P. Thomson. The number of well-known names in this list is a witness to his achievement of making the Cavendish the most famous physics laboratory in the world.

The other feature of the Cavendish tradition which he created was the simplicity and almost crudeness of the apparatus with which his great experiments were carried out. Simplicity always characterizes pioneer research; it is only in the later stages when a fuller development takes place that elaborate and costly apparatus becomes necessary. In J. J. Thomson's work the simplicity was carried to extremes. "String and sealing-wax" was no exaggeration, it was the Cavendish tradition as long as he reigned over it. Occasionally students coming from other centres smuggled into the Cavendish equipment on a more lavish scale, and I well remember as a young research student with what awe and envy we looked upon the possessors of pieces of apparatus which must have cost sums expressed in pounds and not in shillings. The theory of atomic structure was born in a tin can. This was characteristic of his genius. There can seldom have been a great pioneer who was so completely independent of the outside world of scientific thought and the conceptions current in his time. J. J. Thomson's school drew its inspiration from his mind alone, and in a few brilliant years started a new era in physics.

W. L. BRAGG.

To CONTRIBUTE a personal note about the work and influence of Sir J. J. Thomson is for me a labour of love. But I would point out that it is written in a hurry with no time to look up references, rather under battle conditions, with air raids in operation a good deal of the time ; and if there is anything in it that anyone disagrees with, I am prepared to discuss it later on when times are quieter.

"J. J." was a great investigator. His methods were his own but in his hands they were effective. He made many important discoveries ; I will only mention two.

He will be immortal as the discoverer of the electron. There were others who were on the fringe of this, but he was the only one who realized that what he had made was a revolution. The others regarded what they were doing as a passing incident, but he followed it up and developed it. It is now the foundation stone of our ideas of the structure of the universe.

In 1881, he wrote a paper in which he showed that a moving electric charge possessed a mass solely in virtue of its energy of motion. This was the birth of the idea that mass was in some sort a measure of energy : a result which is generally attributed to Einstein. But a good many masons, notably Larmor, worked at that building before Einstein pointed at it.

My main impact with Thomson started in 1900, when I graduated at Trinity College and started working in the Cavendish Laboratory. His personality seemed to me terrific, and it was. After six years I felt that if I stayed there much longer I should not have any personality of my own left and in 1906 I went to Princeton.

"J. J." was a good lecturer, but his lectures always seemed to me more like a barrister's brief than a model of scientific reasoning. It was not that way he built up so many supercharged investigators. The main thing was his vital personality, his obvious conviction that what he and we were all doing was something important, and his camaraderie. His knowledge of athletic records was incredible ; he was a veritable Wisden of all the sports. Also seeing the important results he obtained with rather poor apparatus encouraged us to persevere in our efforts with the very inferior equipment of the Cavendish Laboratory at that period. No doubt the time also was opportune, but he was the man for the time.

This is a difficult analysis really, but whatever it was and however it happened he built up at the Cavendish Laboratory the greatest school in experimental physics that had ever been built up anywhere until that epoch. It would exceed the limits of this article to write out a list of those who achieved high distinction and there is also the difficulty of deciding just where to draw the line. But I can mention a list of names which express a definite fact and that is those of his pupils who have been Nobel Prize winners. The award of these prizes started in 1901. He himself was awarded the prize for physics in 1906. The Nobel Prizes awarded to his pupils were : Rutherford (1908), W. L. Bragg (1915), Barkla (1917), Aston (1922), C. T. R. Wilson (1927), O. W. Richardson (1928), G. P. Thomson (1937). There is no one else who can show a list of eight Nobel Prizes awarded to him and his pupils during his lifetime and it is unlikely that there ever will be. All these people actually received the important part of their training under "J. J." and in the Cavendish Laboratory.

He was a great inspirer. I cannot think of any other man who, in such measure, did so much intellectual good to so many others in his own lifetime. OWEN W. RICHARDSON.

SOME forty years ago while studying physics under Poynting at Mason College I first met the great "J. J.". Though with no inkling of his future decisive influence upon my life, I was impressed with his striking personality. Eager desire for knowledge burnt in him like a fire, and he had the happiest knack of kindling it in others. His remarkable work "Conduction of Electricity through Gases" must have been an inspiration to many. It certainly was to me, and stimulated my research on vacuum discharge which ultimately took me to Cambridge to be his research assistant during 1910–13. Although this was comparatively late in his career as Cavendish professor, his fertility in ideas still appeared to be inexhaustible and supplied the whole laboratory with subjects for research. Still more amazing, and to me akin to magic, appeared his intuitive ability to diagnose the cause of trouble in an apparatus without working with it, for he had no manipulative skill.

"J. J." was an excellent lecturer with a voice that, on occasion, could surmount any acoustical difficulties or, more accurately, blast its way through them. Presiding at tea-time he was immense, and many of his pupils have since recounted how stimulating was his talk on all manner of subjects. Next to his natural kindliness, the character which endeared him most to the townsfolk of Cambridge, and gave rise to so many amusing and apocryphal stories, was that of the absent-minded professor careless in habit, wrapt in deep thought, gazing with unseeing eyes into the most unsuitable shop-windows. But beneath this dreamy exterior lay a shrewd North Country efficiency with which he ran, on a minimum outlay, his great laboratory, producing in a steady stream

distinguished occupants for the chairs of physics in universities all over the world, a world which was just awakening to the vast and imminent importance of the subject. These men, when confronted with the gigantic engineering team-work of modern high-voltage plants, may well look back, sometimes with regret, to those simpler days of gold leaves, tobacco tins and sealing-wax. His was a splendid life covering as it did that most prolific period of scientific renaissance inaugurated by argon, X-rays, and his own discovery of the electron. His passing marks the passing of an era.

F. W. ASTON.

IT is not easy even to recapture any adequate sense of the influence which J. J. Thomson exerted on science in schools in the earlier days of this century. Electrons and J. J. Thomson were spoken of mysteriously by physics masters with the same bated breath. He came into my life, as into those of so many others, long before I came up to Trinity, when as a schoolboy I got hold of a copy of the "Discharge of Electricity through Gases", devoured it, found it much too hard to understand, resented especially its use of integral signs (which I had not yet "got to"), but gained such thrills from the parts I could understand that I even read it on Sundays, and found it worth the rebuke I received at home for violating the Sabbath. It sent me to his early *Phil. Mag.* papers of 1880 or so, on the stability of rings of charged corpuscles inside a sphere of the opposite sign of charge. One may be allowed to recall that "J. J." was a mathematician before he was a physicist. Afterwards, when one had come up to Trinity, one heard it rumoured that "J. J." liked doing his mathematics for himself, but that when in difficulties he had recourse to "J. L." next door.

As an undergraduate reading not physics but mathematics, one's contacts with him were indirect; one envied those who brought tales of his lectures at the Cavendish on "Properties of Matter", or the research students who brought tales of the laboratory teas there. One set of pictures, however, remains: those of "J. J." regularly attending Sunday evening chapel in Trinity, coming in at the very last moment, with surplice and M.A. hood, standing at the right moments with these articles of dress peculiarly crooked, and looking as if his soul were far away—a notable contrast to his saintly looking predecessor in the Master's pew. Later, one got to know and be thankful for his kindly courtesy to junior fellows, for the avoidance of whose awkwardness he so readily provided conversational opportunities, covering up one's more unusually fatuous remarks with the characteristic resonant half-grunt, half-laugh that concluded his own sallies. He had withal a somewhat disconcerting directness of suddenly asking a question pertinent and penetrating, amidst the vagueness of introductory conversations; and his face, previously turned aside as though interested (as in Chapel) in things miles away, would gleam with enjoyment as he thought of some teasing but kindly remark to make about the common acquaintance he had inquired after. His best story about physicists can scarcely yet be re-told, for the protagonists are still living; but the pungency of his description of the final interview between those heroic figures was worthy of the tradition maintained by masters of Trinity: "both were speechless, the one silent from rage and the other for the usual reason". On one of the occasions on which I heard him tell this story he slyly added: "And when one of them later wrote a book about physics, and NATURE asked me to review it, instead of doing so I filled in the little empty space at the bottom with the name of the other". History does not record whether NATURE took that advice, whether if so the review was written, and if so again whether it was printable. Thus did "J. J." make his open study on late Sunday evenings a place of scientific gaiety.

E. A. MILNE.

IT was Prof. J. J. Thomson's name which took me to Cambridge in 1906. His lectures on electrons and the structure of matter introduced me to a domain of observation and thought new to me, and deflected my interest from more abstract mathematics to the atomic and sub-atomic world. It is not easy to describe the nature of the fascinating influence of Thomson's teaching. There was nothing sensational about it; but the apparent simplicity of the experiments and the straightforwardness of the explanation carried a striking power of conviction. When I left Cambridge I was converted to physics.

More than fifteen years later, on a visit to Cambridge, I met Thomson's son, who took me to the Cavendish and into the basement room where "J. J." was working, surrounded by the usual complicated structures of apparatus, glass tubes and wires. I was introduced: "Father, here is an old pupil of yours who studied with you years ago. . . ." The grey head, bent over a glowing vacuum tube, was lifted for a minute: "How do you do. Now, look here, this is the spectrum of . . .", and we were in the midst of the realm of research, forgetting the chasm of years, war and after-war, which lay between this rencontre and the days of our first acquaintance. This was Thomson in the Cavendish: science personified. But this fanatical objectivity did not

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conceal the human side of his nature, that of a man of the highest culture, of sound practical wisdom, of great kindness of heart.

Again, many years later when, expelled from my own country, I was invited to Cambridge, I found in Thomson's home, the venerable 'Lodge of Trinity', the kindest hospitality and friendship. It is to express my deepest gratitude for all he has done for me, in science and life, that I write these lines.

MAX BORN.

DANS l'autre lutte, celle que l'homme livre contre l'inconnu, un combattant vient de disparaître, qui lui avait consacré toute sa vie. En d'autres temps, les figures les plus illustres de la science contemporaine seraient venues s'incliner devant sa dépouille, et auraient rappelé en termes appropriés l'influence de Sir J. J. Thomson sur tant de domaines de la physique et de la chimie modernes, dans tous les pays. La France en particulier, dont les savants doivent tant à l'œuvre de J. J. Thomson, aurait apporté, par la voix de mes maîtres, son hommage au grand savant qui vient de mourir. Hélas, parmi les savants français qui auraient pu le mieux prendre la parole en ces circonstances, les uns, tels que Marie Curie et Georges Urbain, sont morts prématurement ; les autres malheureusement, ne sont plus à même de nous communiquer leurs sentiments.

C'est donc à moi, leur humble élève, exilé sur la terre libre, que revient l'honneur de venir dire aujourd'hui ce que J. J. Thomson représentait pour la science française. Si j'ose l'entreprendre, c'est que j'ai la certitude de pouvoir le faire au nom des maîtres que j'ai cités, car ce sont eux qui m'ont appris à connaître et à respecter le grand savant anglais.

J. J. Thomson était Docteur ès Sciences de la Sorbonne ; il était membre de l'Académie des Sciences de l'Institut de France et Lauréat du Prix Mascart. Mais son influence sur la science française a été bien plus grande que ne peuvent l'indiquer ces trois symboles.

Né en 1856, J. J. Thomson a été l'un des artisans de la prodigieuse évolution de la physique qui a commencé à la fin du siècle dernier. Ses travaux sur la décharge électrique à travers les gaz (1897), contemporains de la découverte de la radioactivité en France, ont permis avec elle le développement de la physique atomique puis, plus tard, de la physique nucléaire. Son œuvre, en ce qui concerne la structure corpusculaire de la matière, est étroitement associée à celle de Jean Perrin, de Paul Langevin, et l'on sait quels fruits a porté cette influence, dans le domaine de la connaissance humaine.

Au nom des travailleurs scientifiques français qui ont pu venir en Angleterre reprendre leur place au combat, au nom de mes maîtres empêchés, au nom de la science française, je m'incline devant la mémoire de J. J. Thomson, l'un des plus grands physiciens du monde. Je prie sa famille, en particulier son fils et continuateur, George Paget Thomson, F.R.S., et sa fille et collaboratrice, Miss Joan Thomson, de recevoir ici, en même temps que Lady Thomson, l'expression des condoléances françaises unanimes, sinon unanimement exprimées.

X.

PROPOSING a vote of thanks at a meeting of the British Association a few years ago, Sir Oliver Lodge described Sir J. J. Thomson as "a man whom posterity will envy us for having known". It is not often that one great man of science finds a perfect phrase in which to express his admiration of another, and the moment is doubly appropriate for putting on record this tribute.

E. H. NEVILLE.

MISCEGENATION IN SOUTH AFRICA*

IT is a matter of general experience that racial questions are rarely debated on their merits. In the discussion of the effects of inter-racial breeding among the different varieties of the human stock, the issue is commonly determined by prejudice masquerading as pride of race or political and economic considerations more or less veiled in arguments brought forward in support of a policy of segregation. No appeal is made to what should be the crucial factor, the verdict of science; and the existence of 'superior' and 'inferior' races which when crossed produce an offspring inferior in character to the superior parent is tacitly assumed. Such indeed was the experience of the Commission on Mixed Marriages in South Africa appointed by the Governor-General of the Union of South Africa to examine whether such

* Report of the Commission on Mixed Marriages in South Africa. Pp. 56. (Pretoria : Government Printer, Union of South Africa, 1939.) 3s.

marriages were likely to be detrimental to the future welfare of the population.

While condemnation of such marriages was found to be universal among those whose evidence was sought, this opinion was based, the members of the Commission found, upon desire to ensure white hegemony in South Africa, or among the more enlightened of the native population on a racial pride, which resented the degradation of their womenkind. Even the members of the Commission themselves in one incidental reference hold the findings of scientific investigation as too inconclusive to assist their deliberations ; and one member, Mrs. N. B. Spilhaus, alone in an individual minority report, has so far the courage of her convictions as to suggest that an infiltration of native blood of long standing may have promoted in the 'white' population a tolerance of an African climate, while averting evils of inbreeding now apparent in sections of the population which have more successfully preserved their racial purity.

The terms of reference of the Commission were in the first place to inquire whether mixed marriages between Europeans and non-Europeans (native, coloured, or other) were on the increase or are likely to increase ; and secondly, as mentioned above, whether such marriages are sufficiently numerous to be seriously detrimental to the welfare of the Union and the future composition of the population.

The Commission, on opening its inquiry, found itself faced with a number of problems, such as definition, official classification for purposes of marriage and the accuracy of the resulting statistics, which, important as they are, must be passed over here. It was found that in the period 1925–1937, for example, the period immediately preceding the passing of the Immorality Act (1937) which made illicit intercourse between Europeans and natives a criminal offence, mixed marriages of all types showed a decrease from 133 or 0·9 per cent to 101 or 0·4 per cent. An increase in marriages between Europeans and coloured in 1935 and 1937 is thought possibly to be an after-effect of the economic depression of 1930, which led to impoverished Europeans and coloured living in close propinquity and thus tending to create conditions favourable to mixed marriages in the younger generations.

While mixed marriages between Europeans and coloured or native are widely disapproved among the public and in the churches, they are not as yet forbidden, save only by implication in the Transvaal, where, there being one law regulating marriage between whites and another for those between non-Europeans, there is no such provision for the mixed marriage which by tradition among the Voortrekkers and their descendants has been regarded as beyond contemplation. The Commission recognizes the great strength of public opinion in South Africa against mixed marriages, but points out that it is not universal and in fact has failed to prevent such marriages. Certain ameliorative measures in social conditions are recommended which should check the tendency to the contracting of such unions and check an increase otherwise probable, but the Commission holds also that "legislative action making mixed marriages impossible should be passed, and that it should be accompanied by other measures directed against illicit miscegenation".

The latter of these two recommendations is particularly stressed by the Commission. Obviously the problem is not the mixed marriage *per se*, injurious in individual instances as this may be, but "the coming into being of a group not only itself unhappily situated in the existing social structure of the country, but also forming a serious social problem" ; and it is added—"The gravity of the situation is increased by the occurrence of a large amount of illicit miscegenation". Illicit intercourse indeed, notwithstanding repressive measures and influences, is the main source of miscegenation. If, therefore, legislation is framed as a guard against mixed marriages, it will be of little effect in countering miscegenation unless supplemented by legislation prohibiting extra-marital intercourse between the same class of persons.

In recent years two bills have been introduced and debated in the legislature but did not pass into law which had as their object to check the growth of miscegenation through the elimination of the mixed marriage. The trend of the arguments were on these occasions, like the outlook adopted here by the Commission, sociological not biological. The undesirability of the product of the mixed marriage, assumed to be racially inferior, is in fact an outcome of its social, economic, and political environment—conditions imposed in the interests of its own white hegemony by a minority of 20·9 per cent against a majority of 70·1 per cent non-European of which 68·8 is native. In other words, out of a total population of 9,589,898, Europeans number only 2,003,857 and 6,596,689 are natives. Even more significant for the specific problem with which the Commission dealt is the fact cited by Mrs. Spilhaus that there is an excess of 17,686 adult European males over adult European females.

The Commission recognizes that its recommendations would differentiate between Europeans and non-Europeans, but states that they are intended in a sense which "would not discriminate in a way unfavourable to the true interests of the latter".

OBITUARIES

Mr. R. C. Mossman

THE death of Robert Cockburn Mossman at Buenos Aires on July 19 removes a natural genius whose scientific instincts found their full expression without the help of a formal scientific training.

Mossman was born in Edinburgh on November 7, 1870, was educated at the Royal High School and entered his father's business, for which he had neither liking nor aptitude. I met him first when he was a boy spending every penny he could get in equipping a second-order meteorological station in his father's garden, and he kept up continuous records there from 1886 until 1900. Dr. Alexander Buchan was quick to recognize Mossman's gifts and encouraged him to make the most of them. One of his earliest labours was an elaborate study of the climate of Edinburgh, which was followed later by a still fuller treatment of the climate of London. He frequently assisted at the Ben Nevis Observatory, often acting as temporary superintendent, and he carried out a series of comparative observations in a hut high up in Glen Nevis, where he lived alone for a year in 1901–1902. He was elected a fellow of the Royal Society of Edinburgh almost as soon as he came of age.

He joined the Scottish Antarctic Expedition under Dr. W. S. Bruce in 1902, taking charge of the meteorological and oceanographical work on the first cruise in the Weddell Sea. While wintering in 1903 at Laurie Island in the South Orkneys, Mossman set up a meteorological observatory on shore, and rather than break the continuity of the record he remained while the *Scotia* made her second trip to the Weddell Sea and so passed a second winter in great discomfort in the miserable climate he was determined to study. Thanks to his representations, the Argentine Government took over the observatory as a going concern, and Mossman paid a visit to Grahamland in the gunboat *Uruguay* to look for Charcot, who was then missing.

Short trips in whalers to Spitsbergen and the Greenland seas occupied the next two seasons and in the intervals he was joint author with two of his colleagues of "The Voyage of the *Scotia*".

Returning to Buenos Aires Mossman spent six years in the Argentine Meteorological Office while Mr. W. G. Davis was director. When my eyes broke down in 1913 I was fortunate enough to have his help for a year in the editorship of "British Rainfall", and he remained in Great Britain until after the War.

Returning to the Argentine in 1920, Mossman filled several posts in the Argentine Meteorological Service in Buenos Aires and Cordova, being acting director in 1928–29 and receiving the appointment of head of the Climatological Department in 1930. He made a profound study of the climate of the southern continents and their relation to the Antarctic regions. The labours of an enthusiast for a life-time necessarily produced a flood of papers and memories. Including official reports, these could not number much less than a hundred.

In 1918 Mossman received the Keith Prize of the Royal Society of Edinburgh for his Antarctic work, and he also received the Gold Medal of the Royal Scottish Geographical Society. He did not concern himself with meteorological theory, but he had no superior in conscientious and tireless labour in the accumulation and orderly presentation of the observational facts on which all theory must be based.

HUGH ROBERT MILL.

Mr. C. H. Turnor

MR. CHRISTOPHER HATTON TURNOR, whose death occurred on August 19 at the age of sixty-six, was well known for his active interest in the science and practice of agriculture. He was educated at Christ Church, Oxford, and then specialized in agriculture at the Royal Agricultural College, Cirencester, where he was one of a remarkable group of students that included also Lord Bledisloe; afterwards he proceeded to organize and develop the considerable estates he inherited from his uncle. Throughout his life he was indefatigable in studying the possibilities of using more science in agriculture, and his sound common sense and instinct for practicability helped him to select those methods most likely to be of value and to concentrate on them. Early in his career he became greatly impressed with the possibility of lucerne growing and he introduced this crop with great success into his system of farming. He also studied in detail the Danish methods of agriculture and engaged the services of an expert Danish farmer to run one of his farms on Danish lines so that he and other agriculturists might be able to see how far they embodied improvements likely to be useful in English conditions.

His interests were very wide and he was unusually well read. He travelled a good deal but never failed to keep his farmer's eyes open, and he invariably brought back a crop of new ideas and suggestions for the improvement of British agriculture by the introduction of some of the methods he had seen. His account of the Pontine Marshes is typical of his travel writings: vigorous and enthusiastic, and punctuated with many shrewd observations about the cultivators and their ways of doing things. His writings on English agriculture included "Land Problems and the National Welfare"; "Our Food Supply" and "The Land and the Empire", in all of which he urged the adoption of a more coherent plan of land utilization in which the landowner should play the part of organizer and leader, with the farmer and farm worker fitting into the scheme

as producers. He had no use for the idle rich or for the man who simply extracted money or pleasure from his estate; his view was that the landowner had a definite place in English country life, with clear-cut duties and responsibilities for which he should train himself and on which he should act. His house was always open as a meeting place for those genuinely desirous to improve country life, and he and Mrs. Turnor were delightful and unforgettable hosts whose influence extended much farther than they realized. Few men strove more conscientiously to live up to their ideals than he did, and one can safely say that if more landowners had been animated by the same high purpose, and laboured with the same success as attended him, the history of British agriculture would have been very different. E. J. RUSSELL.

Dr. R. Hanitsch

DR. RICHARD HANITSCH died at Oxford on August 11 last. Born at Grossenstein, Germany, in 1860, he graduated Ph.D. in the University of Jena. During 1887–1895 he held the post of demonstrator in zoology in the University of Liverpool. During this period he took an active interest in marine biology and became an authority on the sponges, a group on which he wrote a number of papers and reports dealing with English, Irish and some of the foreign species. He also contributed, for a few years, the sections dealing with the literature on sponges and Protozoa to the *Zoological Record*, ending in about 1894. Dr. Hanitsch also contributed short papers on other zoological subjects including the pineal eye of Anguis and the structure of Limax. The two last-named were printed in the Liverpool Biological Society's *Transactions*.

From 1895 until 1919 he was director of the Raffles Museum at Singapore and during this period he became interested in Blattidæ. He contributed various papers on their systematics and continued the study of these creatures until about a year before his death. Dr. Hanitsch was also interested in numismatics and wrote several articles on this subject. In 1892 he married Miss Ethel Vernon of Liverpool and had five children. A. D. IMMS.

Dr. R. Hanitsch came to Oxford after the War of 1914–18 and in the Hope Department of the University Museum continued his studies of Malaysian Blattidæ until failing health finally prevented further work in 1939. At the time of his death, papers on the Blattidæ of New Guinea, Federated Malay States, and Borneo were well advanced. He had written thirty-two papers on Blattidæ, mainly oriental, in which 17 new genera and 218 new species were described. As a result of this work, and the previous work of Mr. R. Shelford, the Hope Department became well known as a centre of study of these insects, of which many types are there preserved. The University awarded him an honorary M.A. in 1935. It is, perhaps, not widely known that in 1899 he conducted an expedition up Mt. Kina Balu in Borneo, though circumstances prevented him from reaching the summit: this resulted in the discovery of new species of reptiles, Amphibia, a new genus of fresh-water fish, many new insects and a new crustacean. G. D. HALE CARPENTER.

Prof. N. T. M. Wilsmore

IT is with great regret that his many friends in Great Britain have learned of the death in June of this year of Prof. N. T. M. Wilsmore.

Prof. Wilsmore was a graduate in chemistry of the University of Melbourne. Although he began his career as a student of engineering, he had to give up engineering science owing to short-sightedness. As a young man, Wilsmore went to University College, London, and worked in the laboratory of Sir William Ramsay, where he carried out many interesting and important researches, amongst which may be mentioned the discovery of ketene. After working some time in London, he went for a considerable period to Germany, where he gained an international reputation for his valuable work—in connexion especially with the determination of normal electrode potentials. Returning to University College about 1904, he became assistant professor of chemistry and greatly developed teaching and research in physical chemistry in the laboratory of Sir William Ramsay.

In 1913 Prof. Wilsmore was appointed professor of chemistry in the University of Western Australia at Perth. Here he built up an important school of chemistry, although he had to contend for many years with very inefficient laboratory accommodation. During the War of 1914–18, he did important war work in Australia and also came to London, where his services in the Department of Explosives Supply under Lord Moulton and Mr. Quinan were extremely valuable.

It may well be said that in Australia Wilsmore, like D. Steele, carried on the great tradition of Sir Orme Masson, and contributed very much to the development of chemical teaching and research in his native country. Wilsmore was specially interested in physical chemistry, and was indeed one of the principal exponents of that science as it was developed by the famous schools of Arrhenius, van't Hoff, Ostwald and Nernst. He was a man of extremely modest and retiring disposition, of great experimental ability combined with vast and accurate scholarship, and much beloved by all his students and colleagues. Towards the end of his life he acted for a while as deputy vice-chancellor of the University at Perth. Owing to the age limit, he retired in 1937. F. G. DONNAN.

WE regret to announce the following deaths:

Prof. E. W. W. Carlier, emeritus professor of physiology in the University of Birmingham, on September 2, aged seventy-eight.

Mr. E. M. Kindle, formerly chief palæontologist of the Dominion Geological Survey (Canada), on August 29, aged seventy-two.

NEWS AND VIEWS

Maintenance of Morale in War-time

DR. EDWARD GLOVER has produced, as a "Penguin Special" entitled "The Psychology of Fear and Courage" (Harmondsworth and London: Penguin Books, Ltd. 6*d*. net), an apposite little book, which though giving evidence of a wide and deep knowledge of its subject, is written in a clear and popular style; in the main it consists of expansions of broadcasting addresses given by the author. It is concerned with morale, military and civilian, but chiefly civilian, in war-time; and it accordingly makes a searching analysis of the causes which may undermine this essential kind of courage. The technique of the enemy throughout his various *Blitzkrieg* campaigns has primarily been aimed at the destruction of morale by dividing against each other the citizens of the countries he intended to violate, by spreading alarming rumours, by disseminating lying propaganda and by playing upon the most vulnerable passions of his prospective victims—suspicion, fear, hatred, and the sense of guilt. Having thus attempted, with what success one knows, to subjugate their minds, he thereafter attacked them, civilians and military alike, by force of arms, overrunning their territories, destroying their cities, and murdering those who had had the temerity to withstand him. These brutally victorious campaigns are fresh in our minds; and we are now ourselves in the forefront of the battle. Our individual morale must not be shaken nor fail us; and those who are apt to be fearful can hearten themselves and strengthen their fortitude by a realization of the nature of the deep-lying causes of fear.

The very sensible and simple advice Dr. Glover gives is the outcome of a profound knowledge of psychology as well as of a wide practical acquaintance with morbid emotional states with which he has met in his dealings with individual patients as a consultant psychotherapist. This theoretical knowledge and practical acquaintance can be applied towards the production (if necessary) and maintenance of morale. It was long ago written that "Every kingdom divided against itself is brought to desolation; and every city or house divided against itself shall not stand" (*St. Matthew*, xii, 25). The enemy has taken this to heart and tried to implement it by lies, boasts and threats. But dissensions within nations are paralleled by dissensions, or technically 'conflicts', within individuals, of which they are usually quite unconscious; and these, established for the most part in early childhood, are what Dr. Glover lays bare. They are the causes of fear and loss of morale. To understand and to realize this is to exorcise, and in all likelihood to cast out, the obsession of fear and replace it by courage. This little book would be of interest at any time; it is vitally interesting now. It deserves the widest possible circulation.

FOR the time being, the printing and publication of NATURE may be delayed. Readers may be assured, however, that such delay, if any, will be kept to the minimum.

U.S. Register of Scientific Workers

IT is announced by Science Service, of Washington, D.C., that a National Roster of Scientific and Specialized Personnel in the United States is being compiled on lines similar to those used in Great Britain for the scientific research section of the Central Register of the Ministry of Labour. This index is being made jointly by the National Resources Planning Board and the U.S. Civil Service Commission, and is under the direction of Dr. Leonard Carmichael, president of Tufts College; James C. O'Brien, of the Civil Service Commission, is executive officer. National non-government organizations co-operating in the early stages of the scheme included the National Research Council, American Council on Education, American Council of Learned Societies, and the Social Science Research Council. As in Great Britain, the membership lists of learned societies will be largely used to get into touch with those having special qualifications; engineers will be included, but only the more specialized medical men, for a register of the latter has been compiled by the American Medical Association. Committees of specialists widely acquainted with various fields of learning will assist in classifying the index, and will also be charged with protecting the present educational and research endeavours which are carrying out important public services.

"The aim of the National Roster is the development of a means for the efficient and rapid but appropriate use of the specialized brains of America in the service of the nation," Dr. Carmichael explained. "Once started and organized, the value of the Roster to many constructive activities of peace-time, especially in connexion with modern personnel and employment services, will become obvious. With the passing of the present emergency, this Roster should not be abandoned, but rather, maintained as a continuing and always up-to-date census of the specialized brains of America. Even in a complete and continuing form, the development and maintenance of such a register will not be expensive in com-

parison with some of the other projects already undertaken for the preservation and effective use of our natural resources. The procedures which will be based upon the use of the Roster are at once effective and truly democratic. The time has come when our nation must be efficient. The National Roster of Scientific and Specialized Personnel is certainly a necessary tool of an effective democracy."

University Course for Officer Cadets

IN order to provide a steady flow of young men with the necessary mathematical and scientific knowledge into the Officer Cadet Training Units, the War Office has arranged for 1,200 men to be trained at selected universities every six months. By this means it is hoped to meet particularly the demands of the more technical branches, such as the Royal Engineers, Royal Corps of Signals and Royal Artillery. The men will be selected at examinations conducted in June and November by the Civil Service Commissioners, after which they will serve in a training unit for three months before proceeding to the selected university. The Government is to make a grant to the universities concerned to cover the cost of these courses. The age limits for those wishing to take the examination in November are 18–18½ by the end of this year; those taking it in June 1941 must be within the limiting ages on July 1, 1941. The first courses, to begin in October next, will be filled by candidates who were between the requisite age limits on June 1, 1940, and nominated by head masters or commanding officers.

Rumania's Cultural Losses

AMONG the consequences of Rumania's loss of territory (Bessarabia and Bukovina to Russia, the Dobrudja to Bulgaria and part of Transylvania to Hungary) are the cultural changes taking place within the ceded lands. The universities of Cernauti (Czernowitz) and Chishinau (Kishenev) and the Observatory at Dubosarii Vechi have been transferred to the Soviet Union. In the Dobrudja there is no institution of university rank, but there are important local high schools. The greatest cultural losses are in Transylvania, where there are many important educational institutions, including the Universities of Kluj (Klausenburg) and Oradea Mare (Grosswardein) and the headquarters and branches of several learned societies. At Kluj, the capital of Transylvania, the University had famous medical and science faculties, and its library was the largest provincial one in the country. Two celebrated museums are lost, namely, the Transylvanian Ethnographical Museum and another with general and local natural history collections.

It is in this part of Rumania that the largest German minority is mainly settled and centres of German culture now pass back to Hungary, though the town of Sibiu (Hermannstadt) with its Brukenthal Museum and German library remain in Rumania. A number of Rumanian men of science and learning have had to relinquish their posts and have been transferred to Bucharest and other places in diminished Rumania. Their colleagues and fellow scientific workers in other lands extend their sympathy, trusting that their work for mankind may soon be resumed in happier circumstances.

Britain's Supplies of Feeding-stuffs

IN view of the actual and prospective shortage of feeding-stuffs in Britain, attention may be directed to the comprehensive study of the situation made by Dr. Norman C. Wright, director of the Hannah Dairy Research Institute, in the *Empire Journal of Experimental Agriculture* for July 1940 (see also NATURE of August 24, p. 251). In this study, which gives detailed trade statistics for the period 1934–8, the author stresses the great part played by our grasslands in providing food for livestock; grazing and hay together supply just under 60 per cent of the protein and starch equivalents consumed. Together with the products of arable land, our home supplies constitute about three quarters of the total available. Unfortunately, however, grass, including hay, is essentially a seasonal product, and the question of supplies in winter during war-time becomes very serious, especially in respect of pigs and poultry, which are mainly fed on cereals and concentrates, and of which we import 70–75 per cent of our requirements. Owing to shortage of shipping and to currency restrictions, supplies of all imported feeding-stuffs will be much reduced next winter, and it seems likely that the pre-War proportions of cereal and oil-seed imports will remain unaltered.

The choice of imports and of crops to be grown for home production should be governed primarily by accessibility of overseas producing areas, by suitability for storage, and by the practicability of diversion to human consumption. The ploughing-up policy, which has already added 2,034,000 acres to our arable land, will eventually increase the supplies of nutrients available for winter feeding, and when the ploughed-up land reverts to pasture there will be a marked increase in productivity. Maximum economy in the use of feeding-stuffs demands a definite order of priority in the allocation of supplies to different classes of livestock. Cereals are the most economical supplies of energy to the human population, and in war-time animal products should be regarded essentially as sources of the 'protective' foods, namely, first-class protein, minerals and vitamins. Milk and milk products are of outstanding value in this respect: eggs are of special value in cooking and for invalid dietaries; meat is of secondary importance; bacon and butter are valuable, but not essential, sources of fat. Everything points to the importance of maintaining our dairy herds and of increasing our imports of cheese, eggs, and bacon from Empire countries, though at present these are exporting practically up to the hilt.

After satisfying the requirements of milch cows, Dr. Norman Wright thinks that feeding-stuffs should be preferentially allocated to poultry and pigs, and not, as has been officially intimated, to beef cattle and sheep, for these provide less valuable animal products at greater feed-cost and can be largely maintained on grass and coarse fodders. The official

preference for beef cattle and sheep is due to their greater indirect effect on soil fertility and to the fact that they take far longer to reproduce than pigs and poultry, but much expert opinion is in favour of Dr. Norman Wright's view.

Sir William Chambers

THE July issue of the *Anglo-Swedish Review* contains an interesting editorial on the life and work of the architect Sir William Chambers, who was born at Gothenburg in 1723, and died in 1796 in London, when he was buried in Westminster Abbey. In 1739 he entered the service of the Swedish East India Company, and the next year sailed to China as a cadet, and in 1743–45 as an assistant. During his stay in China he devoted himself to the study of Chinese architecture, which exercised a considerable influence on his future. The importance of Chambers is due to the fact that he was the first to furnish accurate information on Chinese architectural interior decoration and garden planning based on personal observations in the East. He made his reputation by the grounds which he designed at Kew, including the pagoda in the gardens, between 1757 and 1762. In 1775 he was appointed the architect to Somerset House. He also designed mansions for Earl Gower at Whitehall and Lord Melbourne in Piccadilly. His principal publications were "Designs of Chinese Buildings, Furniture, Dresses, Machines and Utensils" (1757) and "Plans, Elevations, Sections and Perspective Views of the Gardens and Building at Kew in Surrey" (1763).

Biology in Australian Schools

AT the first public meeting of the Victorian branch of the newly formed Association of Scientific Workers (Australia) held on March 19 in the University of Melbourne, the place of biology in school education was discussed. Prof. J. S. Turner pointed out the inadequacy of the present teaching of science in schools and said that the child is only educated for life if his school science includes an introduction to biology in addition to training in chemistry and physics. The solution of many problems of a troubled world requires biological knowledge—it is enough simply to enumerate them: education, hygiene, nutrition, quack remedies, racial prejudice, population drifts, immigration, agriculture, forestry, soil erosion. Going on to give some statistics regarding Victoria, he showed that inquiries at 36 large schools (including 4 of the largest public schools) revealed that 17 of these schools do not teach biology at any stage to their 6,300 pupils. At the other 19 schools there are 8,000 pupils, 2,500 of whom were of Intermediate or Leaving standing. Of these, 254 take biological science, 230 botany, 570 zoology. In Victoria there are 150 State Secondary, High and non-State Secondary schools, and in only 77 of these is any kind of biology taught. Of the 77 schools teaching biology only 5 or 6 are boys' schools or mixed schools, and it appears probable that in any one year only a hundred or two hundred boys in the whole of the State are introduced in a scientific study of animals, plants and man. Of the 3,500 boys and girls who in 1938 took English and arithmetic in public examinations, 2,050 took also British history; 400 (all girls) took botany, 500 (about 100 boys) took zoology and 72 took agricultural science.

Prof. S. M. Wadham discussed the lack of biological training in citizens in connexion with the various political systems; he pointed out that the successful introduction of biology in English schools during the last decade was in part due to the decision to allow medical students to pass their first M.B. examination while still at school. Biology is largely a cultural subject, and its introduction into schools would be opposed unless it could be shown to be of direct advantage in later life. Mr. Colman, Inspector of Schools in Victoria, agreed that an extension of biological teaching was desirable, but discussed the difficulties of school time-tables. He showed that attempts were being made to introduce courses of biological and physical sciences into the State schools. Miss Cunningham, of Fintona School, gave her opinion that time-table difficulties are by no means insuperable, and thinks that there can be no argument as to the cultural value of biology in schools. She has introduced a compulsory course dealing largely with human physiology and she found her pupils vitally interested. Prof. R. D. Wright said that the average person's abysmal ignorance of dietetics and normal functions is to be deplored. He is inclined to the view that biology, dealing with variable material, is of greater value as a school science than pure physics or chemistry.

Conserving Supplies of Potash Alkalis

WITH the object of ensuring that the reduced supplies of potash compounds shall be used to the best advantage the Ministry of Supply has made an Order under which purchases by consumers of caustic potash and carbonate of potash may be made only under licence. Licences will not be granted except in cases where substitution of potash by soda is impossible, but for the present, lots not exceeding half a ton a month are exempt from the Order. Compared with the vast quantities of potassium compounds used as fertilizers the amount used in the manufacture of medicinal salts is small; at a rough estimate it is probable that it does not exceed 5 per cent of the total consumption of potash; but it is desirable, nevertheless, that medical practitioners should prescribe sodium or ammonium compounds instead of potassium compounds whenever this substitution can be made without prejudice to patients. For example, sodium or ammonium bromide should be used instead of potassium bromide and sodium iodide in place of potassium iodide; and so the list might be extended. In the aggregate, the quantity of potash saved for potatoes and other market garden crops and sugar beet, for example, would not be inconsiderable.

Infectious Diseases and Aeroplanes

IN a recent thesis (*Thèse de Paris*, No. 217; (1940), Dr. J. M. Chauvisé remarks that in addition to the precautions applicable to passengers on aeroplanes

coming from countries in which malaria, yellow fever and dengue are present, special prophylactic measures are necessary for destruction on the aeroplanes of the insects carrying these diseases. This prophylaxis should be carried out both on departure by a rigorous supervision of the openings in the machines and on arrival by a careful examination of the machine and a search for the hiding places of dangerous insects. The method at present employed consists in the use of a spray with various kinds of pyrethrum, though flies, ticks, bugs and other sorts of insects are not destroyed by it. Disinfestation of the machine during flight should be carried out by an apparatus containing a mixture of pyrethrum and carbon tetrachloride possessing the following characters: (1) it should be rigorously non-inflammable; (2) it should have no injurious action on metals or materials; and (3) it should not irritate the passengers' mucous membranes. Inspection of the aerodrome should include a search on the aeroplanes for the internal and external hiding places of mosquitoes into which ordinary disinfestants cannot enter without direct spraying. There is a general tendency to neglect entirely the outside of the aeroplanes, although it contains numerous possible places of concealment for mosquitoes.

Food of Fur Animals in Captivity

PRACTICALLY the only animals that are now being bred commercially for their fur are silver-foxes, minks and rabbits. Others have been tried, but costs of feeding, overhead charges generally, and difficulties of inducing breeding in captivity made the price of the skins greater than that of equally good wild-caught examples, so that the undertakings came to an end. To some extent, the first needs in this relatively new industry were the testing of equipment, the perfection of methods of management, and the control of diseases and parasitic infestations. These problems have been tackled, but until recently no attempt had been made to discover by controlled experimental work the diets most suitable as regards results and costs for the carnivorous animals recently taken from the wild. The Yearbook of Agriculture for 1939 of the U.S. Department of Agriculture contained an article by Charles E. Kellogg on "Nutrition of Fur Animals", which has been reprinted as Yearbook Separate No. 1717 (U.S. Govt. Printing Office, 1940). It contains in 22 pages a summary of the scientific work carried out at the four or five experimental stations in the United States where nutritional research with fur animals has been carried out. It is impossible to indicate the findings here; but they should be of value to breeders of fur animals in this country, whenever circumstances permit again the development of the fur-farming industry.

A Flooded Power Station

ON August 20, 1939, a flood occurred at Tientsin in China which is stated to have been of unprecedented dimensions even for that part of the Far East, where floods are not infrequent. Mr. F. A. Matthews, chief engineer of the Electricity Department, British Municipal Council, Tientsin, tells a graphic story of this terrible flood, according to the *Electrical Times* of August 8. Despite elaborate precautions, within a few hours the water forced its way into the station basements of the hydro-electric plant until the depth of the water was 6 ft. 6 in., and the power station was crippled for five weeks. The dyking of the power station compound and entrance was commenced immediately and in about four weeks it was possible to hold the flood waters at a safe level by pumps. Reconditioning of the flooded auxiliaries followed, and on September 24 the department was able to take over the load of the area from the Belgian Tramways Co., which had been giving a temporary supply.

The two large Metro-Vick turbo sets, each of 2,500 kw. capacity, had perforce to stop during the floods, and the opportunity was taken to recondition them. Alterations and improvements were also made in the boiler plant, giving marked betterment in coal consumption and heat recovery. Earlier in the year, restrictions and blockade had had an adverse effect on load conditions generally and many factories had to shut down. Members of the Electricity Department staff living outside the concession found it extremely difficult to get to and from their homes, and they had therefore to be housed within the Concession's boundary. In the latter part of the year, load conditions improved, and records were made by both income and profits.

July Earthquakes

THE U.S. Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has made a preliminary determination of the epicentres of five earthquakes which occurred during the early part of July 1940. The first on July 6 had an epicentre in the sea to the north of Toco in Trinidad, and a fairly deep focus, probably of the order of 175 km. The second on July 10 took place to the north-east of Kirin in Manchukuo. This may have been a very deep focus earthquake with a depth of focus in the neighbourhood of 450 km. The third on July 13 was in the Pacific Ocean to the south of P. Burica in Central America. The fourth on July 14 had an epicentre near Rat Island in the Aleutian Islands group, and the fifth on July 19 had its epicentre in the sea bed to the north of Attu also in the Aleutian Islands group. The above determinations, based on reports from twenty-two seismographic stations, indicate the continuation of recent activity in the Aleutian Islands, and off the Pacific coast of Central America. The shock near Trinidad is a continuation of previous activity and the deep focus earthquake near Kirin extends to the north-west the previously known Japanese deep-focus portion of the circum-Pacific belt.

Indian Statistical Conference

THE second session of this Conference was held in Lahore in January 1939; the Proceedings were published in March 1940 and were received here in August (Edited by P. C. Mahalanobis. Pp. ii+168. Calcutta:

Statistical Publishing Society, 1940.) As in the first session a year before, there were sections dealing with theoretical statistics, agricultural statistics, and economic statistics, but an anthropological section has been added. The medical and public health section has disappeared, which is rather surprising, in view of the recent creation of the new post of medical statistician to the Government of India and a separate post for vital statistics at the All-India Institute of Hygiene and Public Health. The annual review by the general secretary, Prof. P. C. Mahalanobis, recalled the long association of the Punjab with statistical work. The study of the connexion between snowfall in the Punjab hills and the monsoon in North India formed the basis of Sir Gilbert Walker's work on weather correlations and his statistical method for long-range forecasting of the monsoon. This led to the concept of world weather; for example, the monsoon in India is controlled by weather conditions six months earlier in Java, Africa, or South America. It was also in the Punjab that pioneer work was done by Mr. Jacob on the influence of rainfall on the yield of wheat. Statistics has played an important part in the Punjab irrigation projects. In the year under review, extensive researches have been carried out in the field and laboratory for the improvement of the jute forecast, a problem of the greatest economic importance for India. The Statistical Institute has actively helped the Government of Bengal in an elaborate crop-cutting experiment for estimating the out-turn of rice. A report has been prepared on certain anti-mosquito experiments undertaken by the Bengal Public Health Department for the control of malaria. A diet survey on a random sample basis has been started in Calcutta. Work has also been carried out on various topics in theoretical statistics.

Education in India

THE "Progress of Education in India, 1932–1937" by John Sargent (Government of India Press, Simla, 5*s*.) is a paper book of 285 pages, well supplied with statistics and diagrams. The report deals with the period before Mr. Sargent became educational commissioner, and we share his feeling that the years which elapse while publication is delayed should be reduced to a minimum. The material is, indeed, vast, but surely the reports of various provinces can be secured and summarized within a year of their receipt. The period has been one of special difficulty, due to financial stress, which did not justify the optimism of the previous report. Several provinces speak strongly about the cramping of education, but retrenchment introduced on economic grounds is being gradually relaxed. Depression has produced a consensus of opinion that the present system is not practical enough in view of the needs of later life—a point in which the United States takes the lead. Secondary education in India needs particular attention.

The Central Advisory Board of Education, abolished in 1923, was revived in 1935 and has received the comments of two experts from England. It was found to be needed when control was handed over to the provinces, and there is enough evidence of that in this report. The Bureau of Education at headquarters was also abolished and revived. The decrease in the number of schools is largely to be attributed to wise measures of consolidation. We note, however, that in five provinces privately managed schools made the cost per pupil lower than in others. But in the whole of British India "the percentage of pupils attending all types of schools to the total population is 5–2 only". This is clearly not enough. Local autonomy has its defects as well as its advantages. Action is taken on grounds other than educational. Party strife and personal reasons have intervened, and the power that membership of a committee gives is noted as used unsatisfactorily in the Central Provinces. Inspectors are not pleased. This is a deep-rooted evil, and it will take some time to create a proper and general sense of responsibility among Indian managers of education.

Announcements

BY an Order of the Committee of Privy Council, the Right Hon. James Gray Stuart, M.P., has been appointed a member of the Medical Research Council in the vacancy caused by the resignation of Mr. R. K. Law, M.P. By another Order, made after consultation with the Medical Research Council and with the President of the Royal Society, Sir W. Wilson Jameson, dean of the London School of Hygiene and Tropical Medicine, has been appointed to be a member of the Council in succession to Prof. Matthew J. Stewart, who retires in rotation on September 30.

IT is announced in *Science* that Prof. Carl Neuberg, formerly professor in the University of Berlin, for twelve years director of the Kaiser Wilhelm Institute for Biochemistry until his retirement with the title emeritus in 1937, has been appointed research professor of chemistry in the Washington Square College of Arts and Sciences of New York University. He will take up the work in September, following his arrival in the United States from Palestine, where he has been teaching at the University of Jerusalem.

THE Borden award of a medal and a thousand dollars for research in nutrition was recently made to Dr. Henry C. Sherman, Mitchill professor of chemistry, Columbia University, New York, for his researches on enzymes, vitamins and the mineral elements in nutrition.

MESSRS. W. AND J. GEORGE LTD., proprietors of F. E. Becker and Co., have recently issued a new 96-page price list of laboratory chemicals, analytical reagents, stains and solutions. A feature which will commend itself at once is the setting out in the body of the list of the maximum limits of impurity to which the analytical reagents conform; and each bottle of 'Nivoc Analytical Reagent' now bears a guarantee to this effect.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They 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.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Night-Shining Eyes

SPELÆOLOGISTS have perhaps rather exceptional opportunities for observing 'night-shining' in human eyes. I have seen it on three occasions with different individuals, and once was accused of exhibiting the phenomenon myself.

On all occasions the observer was below the object and the illuminant was the concentrated beam of a focused electric torch. The glow from the eyes is a most uncanny tawny orange, causing exclamations of horror.

Once only have I seen night-shining by a human outside a cave. An Indian woman, who was bending low down, looked back from that position at the headlights of my car—a momentary gleam from her eyes, which ceased as she stood up and faced the light. Hence the incidence of the light on the eyes on this occasion was similar to that on the previous occasions in caves. Is it possible that the normal individual only exhibits the phenomenon when, with dilated pupils, he is caught by a concentrated beam of light coming from this rather unusual direction?

E. A. GLENNIE,
Regional Recorder (India),
British Spelæological Association.

Dehra Dun,
United Provinces,
India.

THE explanation of "night-shining eyes" is well known. The retina and choroid act as a mirror. In the emmetropic eye the light reflected from the fundus emerges in a parallel beam; hence none of it can enter an observer's eye unless this is placed in the comparatively narrow beam of light—the principle of the ophthalmoscope. In highly hypermetropic eyes the emergent beams are widely divergent, and therefore an observer's eye can see a reflex from the pupil over a considerable area. Glioma of the retina in a baby is usually discovered by the mother noticing a yellow reflex from the pupil, as the so-called "amaurotic cat's eye".

The eyes of most lower mammals are usually highly hypermetropic, and many of them are provided with a special reflecting membrane, absent in man, the tapetum. This occurs in two forms, a fibrous and a cellular, sometimes provided with crystals. The tapetum causes iridescence in the reflected light—hence the variety of colours investigated by Mr. E. D. Walker (see NATURE, March 30, p. 506).

The rareness of the observation of "night-shining" in human eyes is due to the facts that the observed eye must be highly hypermetropic (or still more rarely very highly myopic), the incident light must be bright, and the observing eye must be so placed that some of the reflected rays enter it.

J. HERBERT PARSONS.

Influence of Temperature on Osmotic Behaviour of Some Crustacea and its Bearing on Problems of Animal Distribution

A SEASONAL cycle in the osmotic concentration of the blood of some amphipods, isopods and decapods has been reported by Widmann[1] and Otto[2]. Both these authors observed a higher value for blood in winter than in summer; the animals examined included marine, freshwater and air-breathing species. In Eriocheir, Otto[2] was able to correlate these changes directly with the temperature of the external medium. Krogh[3], reviewing the subject, mentions that the ecological significance of these facts is unknown.

Working on the osmo-regulation of Palæmonid prawns, I find that *Leander serratus* and *Palæmonetes varians* show a similar behaviour in having slightly higher osmotic values in winter than in summer. Both these prawns normally maintain their blood concentrations at a steady state hypotonic to the environment when in sea water[4,5]. During summer, the mean values for osmotic pressure of blood of the two prawns were about 2·3 and 2·6 per cent NaCl respectively; the corresponding values for last winter were 2·4 and 2·8 per cent NaCl. These differences are not insignificant when it is remembered that both these prawns are more or less homoiosmotic, and especially *P. varians*, which shows only a difference of about 0·5 per cent NaCl in internal-osmotic pressure for a change in environment of 3·5 per cent NaCl. It may also be mentioned that neither of the species shows any appreciable osmotic change in response to changes in salinity of sea water between 3·3 and 3·5 per cent NaCl, the normal limits of variation of Plymouth tank water.

Experiments under temperature control which are in progress show that the above-mentioned seasonal variation is independent of other factors like starvation and moulting. When prawns are transferred directly from normal to dilute sea water the mortality is higher in winter than when the temperature is high. The data so far obtained also indicate a *lower* dilution curve for blood of animals kept at a *higher* temperature, in substantial agreement with the observations of Otto[2] who found that Eriocheir transferred from sea water to tap water showed after four days an osmotic pressure of $\Delta 1{\cdot}355°$ C. (2·32 per cent NaCl) at 13° C., but only $\Delta 1{\cdot}27°$ C. (2·18 per cent NaCl) at 23° C. These results show that (*a*) the optimum osmotic pressure of homoiosmotic species falls with rise in temperature of the medium; (*b*) in diluted media the minimum osmotic pressure of blood compatible with life is lower the higher the temperature, and hence the osmotic work required in maintaining hypertonicity is less at higher temperatures. It follows, therefore, that in euryhaline species where the mechanism of

maintaining hypertonicity is well developed, the range of tolerance to dilution of the environment is greater at higher temperatures and that a marine species which may only have feeble powers of regulation can penetrate into brackish water far more easily at higher than at lower temperatures.

These facts appear to be highly significant in the light of certain problems in animal distribution. It is well known that *Palæmonetes varians* which lives in brackish-water in northern Europe inhabits fresh-water in the coasts of the Mediterranean and that closely related fresh-water species exist in North Africa and other tropical regions. There are many other instances of true salt-water species of northern latitudes being represented in fresh-water by similar or identical species farther south in warmer regions. In all these cases, it would appear that the influence of temperature on osmotic behaviour in enabling a species to have a wider limit of tolerance to dilution of the environment is a probable physiological explanation of this peculiarity in distribution. Ecological observations on some other Crustacea have shown an inverse correlation between temperature and salinity[6,7,8].

The active colonization of fresh and brackish waters by marine animals is a characteristic feature of tropical coasts and it has often been explained by the familiar hypothesis of Von Martens[9] of the relative evenness of temperature of tropical waters, and the high rainfall and the presence of large rivers opening into the sea which profoundly alter the coastal salinities. Of all these factors, temperature is probably the most important since in the tropics the difference between the air, sea- and fresh-water temperatures is relatively small in addition to the fact that tropical fresh-waters are not liable to freezing. It is usual to find specialized brackish-water faunas even in places where the coastal salinity is not appreciably altered either by heavy rainfall or by large rivers[10]. The fact that high temperature reduces the optimum osmotic pressure of animals in diluted media and increases their range of tolerance to lower salinities would seem to be a physiological reason for adaptation to brackish and fresh water taking place more actively in warm seas than in cold.

N. KESAVA PANIKKAR.

Marine Biological Laboratory,
Plymouth.
August 22.

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Relative Kidney Weights of Male and Female Mice

IN a recent publication[1] it is reported that treatment with androgens produces great hypertrophy in the kidneys of male mice. Testosterone propionate alone increased the relative kidney weight (average kidney weight in mgm. per gm. body weight) by 35 per cent in comparison with untreated mice, while simultaneous administration of œstrogen produced an increase up to 80 per cent. These authors do not say whether they have ascertained if any difference between the two sexes in kidney weight is found in normal mice.

In this Institute, data upon this matter were obtained in the course of an investigation of possible pre-cancerous factors in several pure lines of mice. The average relative kidney weight for 16 male mice of the C_3H strain, age 35–195 days, was 14·1 mgm. per gm. The corresponding value for 16 female mice of the same strain, age 35–244 days, was 12·6 mgm. per gm. The extremes in the two groups were 11·7–16·7 mgm. and 11·2–15·3 mgm. respectively. The difference between the two average values (1·5 mgm.) is significant ($t = 3·1$). Differences of the same order were found in mice of the Dilute Brown and of the *CBA* strain (4 mice of each sex in both strains). When the data for mice of these strains (48 mice in all) are pooled, the average relative kidney weight obtained is 15·2 mgm. (male) and 12·9 mgm. (female).

No significant difference between the relative liver weights of the two sexes was observed.

This sexual difference in the kidney weights may be related to the microscopical observation of Crabtree[2], who found hypertrophy of the parietal layer of Bowman's capsule in 89 per cent of adult male mice and in only 13 per cent of adult females.

Afterwards some corresponding data for untreated rats were found in the literature[3], which indicate that the average relative kidney weight of the male exceeds that of the female.

F. L. WARREN.

The Chester Beatty Research Institute,
The Royal Cancer Hospital (Free),
London, S.W.3.
August 24.

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A Prolific Trematode

THE asexual generation of the trematode *Cryptocotyle lingua* Creplin is passed in the winkle, *Littorina littorea* L. A miracidium, hatching from a single egg of which many thousands are laid, gives rise to rediæ which feed upon the tissues of the host, and in their turn liberate free swimming cercariæ. In 1935, we collected a large winkle infected with this parasite, and kept it in a finger-bowl of sea-water for five years. During the first week in captivity the winkle, living on a diet of Ulva, emitted an average of 3,300 cercariæ a day, reaching a grand total of approximately 1,300,000 in the first year. Cercariæ have emerged constantly ever since, although there has been a gradual decrease in numbers, so that during August 1940 the mean has fallen to a mere 830 per day. Although at the time of capture the winkle was the largest specimen among hundreds collected, and despite the drain on its constitution, it has since increased its shell size by $3\frac{1}{2}$ mm.

When it is considered that in some localities the percentage of gastropods infected with trematode parasites is high (reaching 40 per cent in the case of *Hydrobia ulvae* Pennant at Plymouth) some idea can

be gained of the astronomical numbers of these free-swimming larvæ. They form part of that section of the marine fauna which, although known to be present, inevitably escapes record in samples of the plankton.

ELIZABETH MEYERHOF.
MIRIAM ROTHSCHILD.

Aston Wold,
Peterborough.
August 19.

A Possible Case of Polyploidy in a Prosobranch Mollusc

IN his recent useful summary in NATURE of July 27, on evidence for polyploidy in hermaphrodite groups of animals, Dr. M. J. D. White remarks that in the pulmonate molluscs (*Helix pomatia* possibly excepted) there is no evidence of polyploidy. Dr. White will therefore be interested in a possible case in another group of molluscs. The species concerned is the parthenogenetic *Potamopyrgus jenkinsi* Smith, of brackish waters. The British form has been studied by my assistant, Dr. Ann R. Sanderson, and in her absence from home (she has been in Australia for some time) her findings were reported for her at the Dundee meeting of the British Association in 1939[1]. Her more detailed paper[2] has been in the press for some time, but war conditions have delayed publication.

Briefly, the British form of *P. jenkinsi* has a diploid chromosome number of between 36 and 44 but Rhein, in a preliminary note[3] without figures or details, stated previously that a Continental form had a diploid constitution of 20–22. The species is very difficult to study cytologically, but Dr. Sanderson's careful studies allow no other interpretation regarding the chromosome constitution of the British form, so that, unless Rhein has misinterpreted his preparations, the possibility exists that the British form is polyploid, and presumably tetraploid, by comparison with Rhein's Continental form.

Comparisons with British forms of related species and with an Australian form of *P. jenkinsi* are being made by Dr. Sanderson, but all that may be reported at the moment is that the dioecious British form of *Peringia ulvæ* (Pennant) shows a diploid count of 36. It may also be mentioned that the only other known parthenogenetic snail, the American *Campeloma rufum* Haldeman, recently studied by Mattox[4], has a diploid count of 12.

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[1] Sanderson, "British Association, Journal of Sectional Transactions" p. 90 (1939).
[2] Sanderson, *Proc. Zool. Soc.*, A (in the press, 1940).
[3] Rhein, *Naturwiss.*, **6** (1935).
[4] Mattox, *Z. Zellforsch.*, **27** (1937).

A Species of Mosquito (Diptera, Culicidæ) New to Britain

On August 20, when examining a batch of larvæ collected that morning at Portsmouth, I found a third instar larva of the culicine mosquito *Theobaldia* (*Allotheobaldia*) *longiareolata* Macquart, a species which has not hitherto been recorded in Great Britain. A further search next day yielded four more third and two fourth instar larvæ.

Other species collected in association with them were *Anopheles claviger*, pupa *Aedes detritus*, *Theobaldia annulata*, *Tsubochrea*, and *Culex pipiens* larvæ and pupæ, of which the Aedes was the dominant species.

The batch of larvæ and pupæ in question were collected from a small pool of rather foul, slightly saline, water at the northern, inner, silted up end of a moat and where a mixed collection of rubbish had been discharged. There was a strong growth of *Spartina Townsendi* on the southern margin.

Dr. Edwards states that *T. longiareolata* is distributed "throughout the Mediterranean and in most of the Atlantic Islands. . . . In France it has been taken as far north as Rambouillet (Villeneuve) but it appears to be unknown in central and northern Europe".

JOHN STALEY.

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August 26.

Blind Seed Disease of Rye-Grass

THE recent communication by Muskett and Calvert[1] concerning the presence of blind seed disease of rye-grass prompts me to put on record the following observations so far made at Wye, Kent, with material collected in east Kent.

In the winter of 1939 a total of twenty-seven samples of rye-grass seed was submitted to me by a firm of seedsmen with a request that they be examined for a disease thought to be caused by Pullularia species. Most of the samples were from old pastures and some from more recently sown Kent indigenous rye-grass ('once-grown'). Tests made by the firm had shown that germination was low for all samples except two which had been specially grown from strains produced at the Welsh Plant Breeding Station, Aberystwyth.

The individual samples were examined on a diaphanoscope and the least translucent and the opaque seeds were selected for dissection. It was found that no less than twenty-five of the samples provided seeds which bore on the caryopsis conidia agreeing with those described by Neill and Hyde[2] as being produced by the blind seed fungus. Cultures made from surface-sterilized caryopses, together with some of the selected seeds, were submitted to Neill at Auckland, New Zealand, who expressed the opinion that the cultures were apparently identical with those obtained in New Zealand from 'blind seeds' of rye-grass and that the seeds themselves were also typical. The presence of the blind seed fungus within the caryopses of rye-grass seed from these samples of low germination strongly suggests that the disease is widespread in the fields of east Kent.

Following the method carried out by Neill and Hyde[2], fifty seeds from each of three of the above twenty-five infected samples were sown in separate pots of sterilized soil and placed in an unheated glasshouse. The sowing was carried out on February 21 and regular observations were made. A number of the seeds from each sample germinated and produced plants. By June 11, a time when the first spikes were flowering, one of the 'blind seeds' from

a pot in the glasshouse had produced an apothecium which agreed with the description by Neill and Hyde of the apothecia similarly produced in New Zealand. On July 23, another seed in the same pot produced two apothecia similarly agreeing and exactly like those illustrated by Muskett and Calvert.

The above facts, together with those given by Muskett and Calvert, show that the blind seed disease is present in Northern Ireland and in England and both the conidial and apothecial stages have been produced. They also confirm the observations of Neill and Hyde, who found the disease in rye-grass seeds grown in England and Ireland.

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August 16.

[1] Muskett, A. E., and Calvert, E. L., NATURE, **146**, 200 (1940).
[2] Neill, J. C., and Hyde, E. O. C., *New Zealand J. Sci. Tech.*, **20**. 281A (1939).

Production of Randomness as a Suggested Measure of Intelligence

IT is well known[1] that attempts to guess numbers at random are usually highly unsuccessful, a fact which suggests the possibility of measuring intelligence by the degree of randomness produced. If asked to produce random numbers from say 0 to 9 inclusive, an intelligent person will at once recognize, and therefore tend to avoid, 'runs' of the type 4567, 9862, etc., and it may be supposed that the failure to recognize a relationship between a number now being spoken and one given a second or so previously will be negatively correlated with intelligence.

That this is indeed the case was strongly suggested by trial, agreement between expectation and subjective estimates of intelligence being often observed. In addition, Dr. G. van Praag of Christ's Hospital, Horsham, has kindly provided eighteen such sets of one hundred numbers each, produced by nine boys specially selected on account of marked contrasts in intelligence, physique and character, together with the 'mental ratios' of the boys concerned. The numbers were examined by the method of 'runs'[2], the average lengths, L_1, L_2, of the 'runs' being worked out for the first and second hundred numbers respectively for each boy. Using the rank order method, the coefficient of correlation between mental ratio and L_1 was $+ 0{\cdot}77$ and for $L_2 + 0{\cdot}40$. The correlation between L_1 and L_2 was $+ 0{\cdot}63$.

While it is not claimed that these figures necessarily prove a correlation of the type suggested, the method is apparently worth investigating, especially as, if successful, it should be easy to construct a mechanical device by which the average lengths of 'runs' would be automatically recorded, thus greatly facilitating the measurement of intelligence. In view of lack of opportunity, I have no wish to reserve this field of research.

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August 16.

[1] Tyrrell, *Proc. Soc. Psy. Res.*, **44**, 99 (1936).
[2] Kermack and McKendrick, *Proc. Roy. Soc. Edin.*, **57**, 228 (1937).

First Use of Current-Bedding to Determine Orientation of Strata

IN a recent communication[1], A. Lamont has directed attention to the application of current-bedding to the determination of the orientation of strata made by John Kelly in 1864. This does not mean, however, that John Kelly was the first geologist to realize the importance of current-bedding, its mode of formation and its relation to the strata. The first, rather crude representation of current-bedding, which I was able to find, was published by MacCulloch in 1819[2] (vol. 3, pl. 18, Fig. 2). This figure refers to the well-known Scalpa Sandstone of Strathaird in Skye, but MacCulloch's description and explanation of this occurrence (vol. 1, p. 348) are rather inadequate. The first correct interpretation of current-bedding was given by Lyell, who in company with L. A. Necker in 1829 had examined a section at the confluence of Rhone and Arve[3,4]. Lyell has also described many examples of current-bedding found in strata of different ages, including the Pre-Cambrian[5]. He was perfectly aware that the truncated parts of the laminæ indicate the upper part of the strata.

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August 14.

[1] NATURE, **145**, 1016 (1940).
[2] MacCulloch, J., "A Description of the Western Islands of Scotland, etc.", London (1819).
[3] Lyell, Ch., "Principles of Geology, etc.", London, vol. 1, p. 254, Fig. 6 (1830).
[4] *Ibid.*, vol. 1, p. 378, Fig. 13 (1837).
[5] *Ibid.*, vol. 4, pp. 78–81, 361–363 (1837).

Visible Sound Waves

I WITNESSED recently from a hill part of the air fighting which took place in a midday air-raid.

I was facing north, in which direction the fighting lay, the sun at its zenith being behind me. In front of me and at an elevation of about 70–80° and at a great height were a number of the exhaust trails from some of the British fighters, which stood out white against a blue sky. I suddenly noticed a number of dark bars equidistantly spaced running along the trails from a north-westerly direction, from which the sound of various explosions could be heard. As the battle moved north and then eastward, so the direction from which the ripples appeared to come altered, and different trains of waves appeared to have somewhat different wave-lengths.

It seems clear that these were the shadows of sound waves shown on the white background of the exhaust trails and caused by the sunlight being differently refracted through the condensations and rarefactions of the waves. The phenomenon was, in fact, analogous to what may be seen when looking through shallow sunlit water on to a sandy beach, where the shadow of the ripples is seen on the sand.

It is probable that many other people favourably placed may have witnessed this very large-scale demonstration of making sound waves visible, but may not have recorded it.

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RESEARCH ITEMS

Early Iron Age Burial, Bedfordshire

AN Early Iron Age site at Eggington, Bedfordshire, excavated in 1931 and described by Frederick G. Gurney (*Antiq. J.*, **20**, 2; 1940) has afforded from an exhumation burial pottery which is discussed by C. F. C. Hawkes, and a human skeleton, described by A. J. E. Cave, remarkable both from the pathological point of view and as material from a period in which in England evidence of the physical characters of the people is scarce. Eggington is three miles east from Leighton Buzzard, and the site a sand bed on the top of the galt hill which has been worked since the Middle Ages. The skeleton lay supine with the right arm flexed across the breast. The left arm, which evidently had lain in the same position, was missing. The legs were drawn up to the left. The skeleton was that of an adult man, strong and vigorous, but short of stature, not exceeding 5 ft. 3 or 4 inches. Pathological changes indicated arthritic affections of the vertebræ and also, severely, of the temporo-maxillary joints, the latter indicating that movements of the jaw in lifetime must have been difficult. The right fibula had been fractured at the junction of neck and shaft and in the right tibia was a serious traumatic lesion at the distal end indicating acute osteomyelitis about 3 inches above the ankle joint. An incised wound on the shin caused by a sharp implement had penetrated to the medullary cavity and the gash had never closed. Although there evidently had been local infection and suppuration, the section had recovered well. The skull is broadly ovoid with a short vertical frontal and a full well-rounded occipital region. The moderate superciliary ridges are short and confluent. The facial skeleton is broad and squared, the nose moderately wide with a well-formed projecting bridge. The skull is micrognathic, and just outside the brachycephalic group: index 79, length 173 mm., breadth 135 mm., auricular height 112. Mr. Hawkes's analysis of the characters of the two pottery vessels which it has been possible to reconstruct points to a period of decadence in Iron Age *A* with suggestions of Iron Age *B* influence in a late pre-Belgic epoch, that is, late third to second century B.C.

Snake Vessel from South-Central Africa

NOTWITHSTANDING the significance of the serpent among Bantu-speaking and other peoples throughout Africa, to which attention has been directed by Sir James Frazer, the occurrence of snake vessels among these peoples does not appear to have been noted in the literature. An unusually interesting specimen has been figured and described by C. van Riet Lowe (*Man*, August 1940). It was bought recently from an itinerant hawker at Mufulira in the 'Copper Belt' of Northern Rhodesia. The vessel is modern, of well-baked clay with an unusually fine finish under a graphite slip. The lid is surmounted by a sphinx-like head with characteristic turban head-dress set in coronets that includes the indented designs of ten cowrie shells, each shell in a separate compartment. On the lower portion of the cylindrical neck of the vessel are two rows of cowrie shells, fourteen indented in each row, while five similar shells appear on the handle. The spherical body of the vase, about 10 inches in diameter, contains three serpents in high relief; on one side a serpent is in the act of swallowing its fellow; on the other side a serpent is shown swallowing a frog. The interesting spout is cylindrical, and includes four rectangular perforations in the circular diaphragm at the end. These do not penetrate directly into the body of the vessel, but follow the coil seen in the front view of the pot. While in certain respects it resembles specimens described from Crete and India, it differs in regard to its lid and coiled spout, but at the same time it has their multiple spout and the serpent. It would appear then that, if there is contact between Crete and India, the influence of the old snake cult may also have extended to south-central Africa.

Pearl Formed Around a Rotifer

THE formation of pearls by molluscs is probably induced more frequently by inorganic irritants than by the presence of animal remains, although both Herdman and Jameson claimed that the responsible agent was generally a parasitic worm. In 1856, Kuchenmeister reported the discovery of a water-mite within a pearl, but records of the occurrence of a free-living animal as a nucleus are very rare. A. E. Alexander describes a rotifer, *Atrochus tentaculatus*, which he found in the central cavity of a freshwater pearl weighing 30 grains (*Amer. J. Sci.*, **237**, 920; 1939). The rotifer measured 0·375 mm. in length, and its chitinous material was well preserved (15 tentacles being represented) indicating rapid deposition of the pearl material. This would appear to be the first record of the presence of a rotifer inciting the formation of a pearl. Curiously enough, the author omits to mention the kind of mollusc from which the pearl was obtained.

Brown Rot Fungi of Fruit Trees

IT has been assumed by Continental workers that, of the brown rot diseases of fruit trees, *Monilia fructigena* (= *Sclerotinia fructigena*) is almost confined to pome fruits, and *M. cinerea* (= *S. laxa*) to the stone fruits. Dr. H. Wormald shows, however (*Trans. Brit. Mycol. Soc.*, **24**, Pt. 1, 20–28, June 1940), that this is not so in Great Britain. He has succeeded in effecting cross inoculations from apple to plum, quince to apple and plum to apple and pear for *M. fructigena*. An extensive series of successful inoculations has also been made with *M. cinerea*, for example, from plum to pear to apple, and the fungi have also been found on a number of species of ornamental shrubs. It is possible to regard *M. cinerea* as the cause of blossom wilt of fruit trees and ornamental shrubs of the genera Pyrus and Prunus, whereas *M. fructigena* is the fungus most frequently associated with fruit brown rot. The paper indicates a number of hitherto unsuspected sources of infection and should make future control of the diseases more certain.

Control of Moulds on Citrus Fruit

J. E. VAN DER PLANK, *et al.* (*J. Pom. & Hort. Sci.*, **18**, 135; 1940), have described experiments on the use of paper impregnated with *o*-phenylphenol for

wrapping citrus fruits. These wraps successfully reduced the number of fruits infected with *Penicillium digitatum P. italicum* and *Trichoderma lignorum*. 5 mgm. *o*-phenylphenol per sq. ft. of paper reduced infections by a half; 9 mgm. (0·44 per cent of the paper weight) gave 87 per cent reduction, but amounts in excess of this caused injury to the rind. Lemons were less easily injured than oranges or grape-fruit. Glyceride oils incorporated in the wrap allowed the use of more preservative without causing injury, and did not reduce the efficiency of the preservative. The wraps are odourless and colourless. They do not taint the fruit or reveal the presence of preservative, which has the advantage of being cheap.

Branchiobdellidæ from North America

THE first adequate description of this striking group of Oligochæte worms was furnished by Odier nearly 120 years ago and this author considered them to be leeches as did other authorities for the next 80 years. From their association with crayfish, they have been and still are by some zoologists regarded as parasites. C. J. Goodnight (*Cont. Zool. Lab. Univ. Illinois*, No. 537; 1940) has furnished a review of the family in North America, where, as is well known, crayfish are numerous. In it 21 species divided among 9 genera are recognized and described. The author concludes from the examination of the contents of the alimentary canals of a large number of specimens that the favourite food at all stages is diatoms. From the records provided it also seems clear that little, if any, host specificity is shown by the Branchiobdellidæ. The fauna of the west coast area is closely related to that of the oriental region.

Piedmont Glaciers

THE piedmont or fringing glaciers of the Antarctic islands around Graham Land have been described by E. Gourdon, on the west of Graham Land, J. H. H. Pirie on the South Orkneys and O. Holtedahl on the South Shetlands, etc. In a recent paper (*Geog. J.*, August), the Rev. W. L. S. Fleming returns to the problem as regards the islands visited by the British Graham Land Expedition of 1934–37. Mr. Fleming argues that the theory of Holtedahl which attributes these glaciers to nivation erosion by freeze and thaw action along the headwall is inadmissible. Many lie below the snow line, all have relatively lofty cliffs at their faces, calving is restricted to the upper parts of the cliff and practically none has moraine matter in its basal layers. Mr. Fleming believes that from these and other characteristics these glaciers, which he terms fringing glaciers, show evidence of being relics of a former more extensive sheet of ice. Their thickness shows no definite relation to the width of gathering ground and in several places the glaciers still show connexion with areas of shelf-ice which may be regarded as relics of a former ice sheet that once filled all the bays and extended beyond the offlying islands. This would explain the present frontal ice cliff which is sometimes as high as 200 ft. Mr. Fleming does not discard entirely the theory that these glaciers have eroded the platforms on which they rest, but he finds certain difficulties in the acceptance of the idea of which the principle seems to be the absence of moraine material in the ice. This lack of evidence of erosive action was admitted by Holtedahl, but he seems to have been satisfied by the discovery of a few englacial boulders in some ice fronts that it was not an insuperable objection to his theory.

Spectrographic Analysis of Singly Ionized Praseodymium

A PAPER entitled "Zeeman Effects and Preliminary Analysis of Singly Ionized Praseodymium (Pr II)" was presented by G. R. Harrison and N. Rosen at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. The magnetic resolution of spectrum lines emitted by the singly-ionized praseodymium atom has been studied at fields up to 95,000 gauss, using a 1,700-kilowatt Bitter electromagnet. Three concave gratings of 10-metre radius were used simultaneously to photograph the spectrum between 2200 A. and 8000 A., giving dispersions of 0·8 A./mm. for the ultra-violet range and 1·6 A./mm. for the visible and near infra-red. The wide hyperfine structure and complicated overlapping of many of the Zeeman patterns render their separation difficult, but several hundred patterns have been reduced to obtain information about spectral terms. Many intense lines are found to be multiplet second-order satellites, indicating wide departures from *LS* coupling, as is to be expected. An unusual number of terms having the same *g*-values are found, possibly indicating a degradation of many terms to a common value through strong mutual perturbations between them. Since the spectrum is rich in lines and of intermediate coupling, no single method of analysis is found sufficient, and it is only by the combined use of improved wave-length measurements, hyperfine structure analysis, Zeeman effect analysis and excitation studies that the many possible quadratic arrays, which applications of the combination principle through the interval sorter and recorder have brought to light, can be critically compared. By using all of these methods a rapidly growing array involving several hundred lines has been set up.

Van der Waals Adsorption of Gases

ACCORDING to S. Brunauer, L. S. Deming, W. E. Deming and E. Teller (*J. Amer. Chem. Soc.*, **62**, 1723; 1940) there are five types of van der Waals adsorption isotherms, typified by the adsorption of (i) oxygen on charcoal at − 183°, (ii) nitrogen on iron catalysts at − 195°, (iii) bromine on silica gel at 79°, (iv) benzene on ferric oxide gel at 50° and (v) water vapour on charcoal at 100°. In the isotherms the volume of gas adsorbed is plotted against the pressure. The first type is the Langmuir isotherm for a unimolecular layer. The authors derive an equation which covers all five types of curve, in which adsorption in capillaries is envisaged and importance is attached to the difference between the heat of adsorption in the first layer and the heat of liquefaction of the vapour (corrected by an additional energy for the last adsorbed layer in a capillary, which is attracted from both sides). The equation is too complicated to reproduce, but it is shown to cover the experimental results and it contains only four constants. It extends the usual theory of capillary adsorption (Kelvin equation) by considering partly filled as well as empty and filled capillaries, and it is shown to provide a useful orientation over a wide range of experimental material. It also includes as special cases unimolecular adsorption and multimolecular adsorption on free surfaces, as well as adsorption in capillaries.

ELECTRICAL PHOTO-ENGRAVING

MR. T. THORNE BAKER describes in the *Electrical Review* of August 23 a new phase of facsimile reproduction for newspaper printing. A study of the literature of early telegraphic transmission of pictures shows that inventors were directed long ago towards the possibilities of receiving a telegraphed image directly upon a soft metal sheet, a cutting tool (operated electro-magnetically by the receiving currents) making an intaglio image which could be printed forthwith. Recent literature on the subject shows that the general opinion nowadays is that it is more profitable to transmit a continuous-tone image from which the screen picture for reproduction can be made by the ordinary methods.

It has been proved that by transmitting a picture by photo-electric scanning to another cylinder rigidly attached to the scanning cylinder, a new means has been established of reproducing photographs which eliminates the camera. This method has opened up a most important field which is likely to have far-reaching effects upon the photo-engraving industry. It applies equally to black-and-white work and colour, and offers, for the first time in photographic reproduction history, a means of reproducing almost perfect copies of any original with little of the 'retouching' and 'fine etching' which to-day makes photo-engraving unnecessarily costly.

In the usual method, the original photograph is attached to the drum of the sending instrument and the surface is scanned by a beam of light which is made to trace a spiral path round the drum, the light after refraction by the picture tones being reflected back on the photo-cell. The amplified output currents from the cell are transmitted to the distant receiving instrument, where they operate a light-valve which exposes a sensitive film, or makes an electromagnetically actuated stencil mark the paper through a sheet of ordinary carbon paper. An alternative method is to use the received currents to operate a high potential glow lamp, the rays of which are concentrated through a tiny aperture upon the surface of the sensitive paper.

Recent sensitometric investigations have indicated the exact losses in tone rendering when making half-tone reproductions by ordinary methods of photo-engraving, in both the high-lights and shadows of the image. In the ordinary way these are overcome by retouching the original, skilled manipulation of the negative, and fine etching of the metal block. It is possible to bias the currents from the scanning unit so as to put back, as it were, what is lost in photo-mechanical reproduction processes. Selecting suitable portions of the characteristic curves of the valves used in amplification, and using the photo-cells themselves under selected conditions, makes it possible to add to or take away from the tones of the facsimile image at any desired densities.

One method of obtaining this result is embodied in a newspaper engraving unit and made by the author for a provincial American newspaper. A transparent film is attached to a drum, actually a glass cylinder, and light from a lamp is focused by a lens, so that the rays come to the periphery of the cylinder. The light beam, after passing through the photographic original, is spread by a negative lens so as to fall on three photo-cells P_1, P_2 and P_3. Cell P_2 gives a straight line reproduction of the image over most of the inner tones. Cell P_1 is so arranged electrically that it records the high-light tones only, and adds density to the upper part of the reproduction curve in the manner indicated by Tritton and Wilson, in the *Photographic Journal* of June 1939. Cell P_3 similarly adds densities in the shadows. The currents from the three cells after amplification are mixed and made to operate a glow lamp, to the rays which the receiving film is exposed. In this way a biased reproduction is obtained, which when received by the half-tone screen in the process camera, yields a half-tone negative from which a block can be made that will give 'perfect' tone rendering without hard work. The *Trenton Times* (New Jersey, U.S.A.), which has adopted the system, prints high-speed offset lithographic four-colour pictures with 120-line screen at 45,000 copies per hour, which is something unique at present in newspaper printing. The primary purpose of the system is to speed up the making of half-tones for newspaper printing.

THE THEORY OF ADSORPTION ON SQUARE LATTICES

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IN a recent paper L. Tonks[1] has criticized the application of the Bethe method to the solution of problems in adsorption. I. Langmuir[2] had earlier mentioned the criticism and supported it. I have already given an answer[3] to Langmuir's remarks so far as was possible before the appearance of the paper by Tonks.

We are concerned with the adsorption on a square lattice of particles so large that, if one site is occupied, adsorption cannot take place on the four surrounding sites. Thus, if a particle is on site *o* in Fig. 1, adsorption on the four sites marked *a* is excluded.

Bethe's method depends on the selection of a small group of sites on which all possible configurations of adsorbed particles are considered, and suitable parameters are introduced to take account of the effect of the particles outside the group on those within it, and *vice versa*. Thus in Fig. 1, if we call site *o* the central site, and the sites marked *a*, *b*, *c* first shell, second shell and third shell sites respectively,

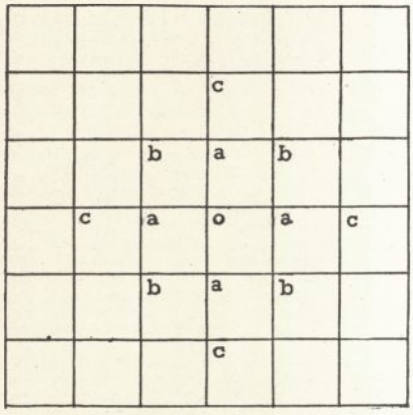

Fig. 1.

SITES ON A SQUARE LATTICE SHOWN BY THE INTERSECTIONS OF THE LINES.

the first approximation would be obtained by considering in detail the central and first shell sites, the second approximation by considering the central, first and second shell sites, and the third approximation by considering the third shell sites also.

It is evident that the first approximation does not include enough detail to give a satisfactory picture of the behaviour of the film. For another special purpose and in connexion with a different type of lattice I considered a group of sites equivalent to the central and first shell sites together with two of the *b* or second shell sites diagonally opposite each other and obtained the form of the isotherm. I have pointed out[3] that this, which is really a freak case, is a very crude application of the Bethe method to the present problem of determining the isotherm, but in spite of this it is a considerable improvement on the first approximation, and gives reasonable results until the film is rather more than half complete, $\theta=0{\cdot}25$. Tonks is quite right in pointing out that this isotherm is inaccurate at higher values of θ, the fraction of sites occupied, and I agree with him that I should not have extended the θ, ξ relation (where ξ is proportional to the pressure p) as far as I did.

In the paper already cited[3] I gave a comparison between the isotherm using the Bethe second approximation and that obtained using some formulæ of Tonks which Langmuir[2] quoted. It is this second approximation against which Tonks's criticism is mainly directed, partly on the grounds that certain parameters do not behave in the way he would expect them to behave. This is a technical point which cannot be discussed in the space available here. I will consider it in a paper which I am submitting for publication (*Proc. Camb. Phil. Soc.*) and will confine myself now to consideration of the final result, namely, the form of the isotherm. This is shown by the full circles in Fig. 2 with the curve drawn through them, and the points with crosses show the isotherm that would be deduced from the formula of Tonks. Below $\theta=0{\cdot}15$ the two are indistinguishable. The second ground for Tonks's objection (see p. 481) is that he found the Bethe method unworkable beyond the second approximation so that the accuracy of the second approximation could not be checked nor could higher accuracy be obtained. The third approximation is correctly formulated, as follows. We introduce parameters ξ, ε_1, ε_2, ε_3 for each particle on central, first, second and third shell sites respectively. These sites must all be average sites, which gives the relations

$$\xi(1+\epsilon_2)^4(1+\epsilon_3)^4 = \epsilon_1\{\epsilon_1^3+3\epsilon_1^2(1+\epsilon_3)+\epsilon_1(3+2\epsilon_2)\ (1+\epsilon_3)^2+(1+\epsilon_2)^2(1+\epsilon_3)^3\}$$

$$= \epsilon_2(1+\epsilon_2)(1+\epsilon_3)^2\{\epsilon_1^2+2\epsilon_1(1+\epsilon_2)(1+\epsilon_3)+(1+\epsilon_2)^3(1+\epsilon_3)^2\}$$

$$= \epsilon_3(1+\epsilon_3)\ \{\epsilon_1^3+\epsilon_1^2\ (3+2\epsilon_2)\ (1+\epsilon_3)+3\epsilon_1(1+\epsilon_2)^2(1+\epsilon_3)^2+(1+\epsilon_2)^4(1+\epsilon_3)^3\}$$

$$= \{\theta/(1-\theta)\}\ \{\epsilon_1^4+4\epsilon_1^3\ (1+\epsilon_3)+2\epsilon_1^2(3+2\epsilon_2)\ (1+\epsilon_3)^2+4\epsilon_1\ (1+\epsilon_2)^2(1+\epsilon_3)^3+(1+\epsilon_2)^4(1+\epsilon_3)^4\}$$

These equations constitute the solution, and give ξ, ε_1, ε_2, ε_3 as functions of θ. The relation between θ and ξ, the isotherm from the third approximation, is shown by the open circles in Fig. 2, and it will be seen that the agreement with the second approximation is very close. The values of ξ for the third approximation points *A* and *B* differ by less than 10 per cent from the second approximation, while the Tonks points in the same region differ from it by about 50 per cent of their value.

The reason for the discrepancy is in part the following. To carry through Tonks's treatment for $\theta>0{\cdot}25$ it is necessary to express certain probabilities, for example, that site *o* and all the *b* and *c* sites in Fig. 1 are occupied together explicitly as a function of θ. He assumes that this probability is proportional to θ^9. This is only true if one assumes that the only sites on which atoms are adsorbed at all are 'even' sites, and such an assumption is only valid in the extreme limit when $\theta\to 0{\cdot}5$. The trouble is that, if one makes this assumption, one is neglecting terms of the same order as those one is trying to calculate. The assumption underlies and invalidates the whole of the Tonks treatment for $\theta>0{\cdot}25$ except in the extreme limit mentioned. In this extreme limit Tonks' method of approach shows that the isotherm is of the form $\xi=2\theta/(1-2\theta)$—a useful result. It is, of course, the trouble discussed in this paragraph that Bethe's approximation is designed to overcome.

On p. 479 of his paper Tonks makes the following statement: "This analysis has recently been made by Roberts (*Proc. Camb. Phil. Soc.*, **36**, 53 (1940)) . . . the nature of the failure of the statistical method is not analysed, but Roberts resorts to an empirical method to handle values of θ_R greater than $0{\cdot}25$. He does not seem to recognize that this technique

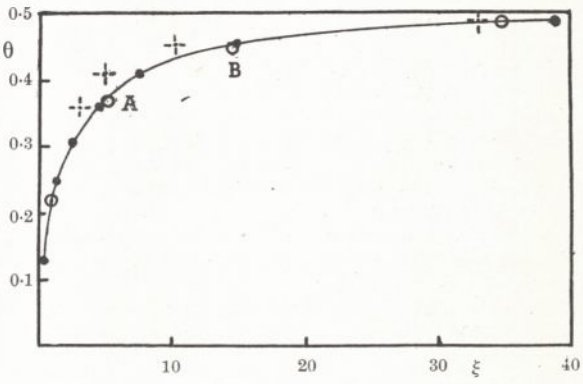

Fig. 2.

RELATION BETWEEN θ THE FRACTION OF SITES OCCUPIED AND ξ WHICH IS PROPORTIONAL TO THE GAS PRESSURE. THE FILM IS COMPLETE WHEN $\theta=0{\cdot}5$. FULL CIRCLES, BETHE 2ND APPROXIMATION; OPEN CIRCLES, BETHE 3RD APPROXIMATION; CROSSES, TONKS.

does not lead to true equilibrium conditions." This statement is wholly false and misleading. In 1935[4] I pointed out that, when an immobile adsorbed film is formed in which each particle in the gas phase occupies more than one site on the surface, the final or complete film will have holes or gaps in it. By an immobile film is meant one in which the energy of activation required to allow a particle to move from one site to another is so much greater than kT that for the duration of an experimental investigation the particles may be regarded as remaining fixed on the sites on which they are first adsorbed. Such films are clearly not in a state of true equilibrium[5] and it was precisely because of this that, in the paper to which Tonks refers, the concern of which was to investigate the properties of these immobile, non-equilibrium films, I used the empirical model to obtain the required results. Its use had nothing whatever to do with the breakdown of the statistical method in the sense used by Tonks. At low values of θ, the properties of the equilibrium and non-equilibrium films will not differ greatly and the statistical method can be used, but at higher values of θ, where the differences are significant, the model must be used. This is clearly stated in the last paragraph on p. 63 of my paper. I may add that I purposely did not plot the isotherm in the paper because for the non-equilibrium film it has no significance. It may be mentioned that now that the third approximation has been worked out, it will be possible to improve the calculations given in my paper (see the footnote on p. 58 of it).

So far, we have been concerned with the effects that arise when the adsorption of a particle on a given site excludes the possibility of adsorption on certain neighbouring sites. The Bethe method is particularly suitable for dealing with this problem. It can also be used to take account of the effects of mutual forces between adsorbed particles and to determine how the heat of adsorption varies with θ, but here, particularly when the forces are repulsive, it suffers from a limitation which I have pointed out[5] and which is quite different from anything discussed by Tonks. In applying the method it is necessary to assume that the interaction energy between particles adsorbed on neighbouring sites is fixed. When account is taken of the fact that the interaction energy is a continuous function of the distance between the particles and that the potential energy of a single adsorbed particle is a continuous function of its position on the surface, it can be seen, as will be shown in a paper by A. R. Miller and myself, which will be published shortly, that the results given by the Bethe method require modification. This has the important practical result that it can no longer be regarded as a necessary consequence of the nature of the observed variation of heat of adsorption of hydrogen on tungsten with θ that this hydrogen film is immobile.[5] I have always felt some difficulty in accepting the truth of this immobility, particularly in view of the fact that the hydrogen film evaporates at an appreciable rate at a comparatively modest temperature.

[1] Tonks, L., *J. Chem. Phys.*, **8**, 477 (1940).

[2] Langmuir, I., *J. Chem. Soc.*, 533 (1940).

[3] Roberts, J. K., *J. Chem. Soc.*, 773 (1940).

[4] Roberts, J. K., NATURE, **135**, 1037 (1935); *Proc. Roy. Soc.*, A, **152**, 473 (1935).

[5] Roberts, J. K., "Some Problems in Adsorption", 23, 38, 33, 34, Camb. Univ. Press (1939). The pages are given in the order in which they are referred to in this communication.

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