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Preservation of Game Animals of the British Empire

A STRAIGHT problem faces the rulers of every part of the British Empire: Is the wild fauna to be left to take its chance at the hands of a native population which has been accustomed to kill without restraint, and in face of the steady encroachments of agriculture, commerce and sport, or is it to be shielded for its own sake and for the sake of posterity? And everywhere the answer is that it must be shielded. Thus a second and more difficult problem is born: To what extent and intensity must protection be carried? For it need scarcely be said (in spite of protection's ultra-enthusiasts) that where a clash arises between wild fauna and human survival or progress, mankind and not its unwitting opponents must have the backing of the State.

Rational legislation for the protection of wild animals (and the protection of the people) must, therefore, endeavour to arrange for preservation without undue multiplication where an animal is already on the down-grade, and for opportunities of destruction—falling far short, it may be hoped, of extinction—where an animal is interfering with the reasonable progress or comfort of humanity. There are few countries in which such rational legislation is in force; for even in lands of long-standing civilisation like our own, where conditions favour detailed and accurate observation, no biological controversies are more strenuous and more indeterminate than those relating to the economic values and the need for preservation or destruction of some of the commonest species. If that is so, how can it be hoped to plan rational laws in the outlying parts of the Empire, where sometimes the need of immediate action seems to be greatest, and where at the same time the balanced knowledge upon which action should be based is least available. Tentative legislation, the effects of which are closely watched and which may be modified at the shortest notice, is the experimental way; but a better way if time allows is to begin by making particular efforts to gather and collate all the information bearing upon the wild fauna in its own relations of numbers, distribution and multiplication, and in its relations to the various activities of humanity, native and non-native. The latter method, with its field surveys and statistics, is being increasingly employed, as every issue of the *Journal of the Society for the Preservation of the Fauna of the Empire* shows; it is exemplified on the best standard in a report just published by the Government of Northern Rhodesia*. The author is Capt. C. R. S. Pitman, game warden in Uganda, whose annual reports on the game of the Protectorate make one of the most interesting and valuable records of the wild life of Africa, and who carried out the Northern Rhodesia survey and investigations in 1931–32 under instructions received through the Secretary of State for the Colonies.

Since the conditions in Northern Rhodesia are fairly representative of conditions in many countries in process of colonisation, the report carries implications of more than local significance. The most general of these is that game, on the whole, has shown a marked decrease in recent years, and that this decrease is progressive, in spite of the fact that a few species have, during the same period, increased enormously in numbers. Natural agencies, as well as man, have contributed to the decrease. Capt. Pitman attributes it, in the first

* A Report on a Faunal Survey of Northern Rhodesia, with especial reference to Game, Elephant Control and National Parks. Pp. xii+500+xxxii+11 maps. (Livingstone, N.R.: Government Printer; London: Crown Agents for the Colonies, 1935.) 7*s.* 6*d.* net.

place, to the great rinderpest epidemic of thirty to forty years ago, which over vast areas wiped out the ungulates, particularly buffalo, eland, lechwe, waterbuck, bushbuck, pig and warthog. Before the stock had had time wholly to recover, the Great War came along, and slaughter for the food of the forces again reduced it "practically to vanishing point" in certain of the provinces. From this disaster most of the species have never recovered, and in their reduced numbers incessant harrying by natives armed with muzzle-loading guns (of which nearly 25,000 have been registered by natives) has caused a progressive decline, and in many localities has brought species to that paucity of numbers which is the forerunner of extinction. Finally, the coming of the railway and the development of mining areas have led to the death of several hundred thousand herd at the hands of Europeans.

The general result is that from districts here and there in which they were once common, species are disappearing: where Broken Hill now stands was once one of the best hunting grounds for the greater kudu, the rhinoceros is all but gone from North-Eastern Rhodesia, the blue wildebeest has vanished from the Awemba district, the lechwe from Kawambwa, game generally from the Fort Rosebery District.

Nevertheless, Northern Rhodesia still remains a land well-stocked. An effort to estimate the numbers of game animals, even though it be regarded as only roughly approximate, is full of interest. Amongst the rarer forms are the giraffe (300 individuals), black-faced impala (500), rhinoceros (1,500), yellow-backed duiker (about 1,500), blue wildebeest (2,000), hippopotamus (3,000); while at the other end of the scale are species such as zebra (50,000), buffalo, roan antelope, Lichtenstein's hartebeest, common duiker (all with about 60,000 individuals), and, far and away the most abundant of all, the black and red lechwes (*Onotragus*) numbering 150,000 and 250,000 respectively. The last two species make up nearly half the total ungulate population of about one million, and this, equally distributed, would average about four individuals to the square mile, or approximately the density of the human population throughout the colony.

In this mass of varieties and of numbers, only some half dozen species appear to be able to stem the current of decline, and only three to make headway against it. The ability to withstand an almost universal tendency depends upon different factors in relation to these select animals and is of great significance from an ecological point of view. Thornicroft's giraffe and Cookson's wildebeest owe their present numbers to the co-operation of the local native authorities in protecting these last representatives of particular races, rather than to any natural power of resistance. The lechwe antelopes have been from time immemorial subjected to great slaughter intensified by a system of extensive driving. In spite of statements to the contrary, Capt. Pitman states that great drives still take place, but yet there is no sign of falling numbers, and this can be attributed only to the enormous annual increase of the lechwe herds. The tsessebe antelope (*Damaliscus lunatus*), curious in its distribution because in Barotse it is abundant on the right bank of the Zambezi and completely absent from the left, has not only been able to withstand the general influences, but has actually increased in numbers from hundreds to thousands in post-War days; and this would appear to be due, first, to its habit of keeping in small herds averaging 20–50 individuals, and secondly to a characteristic shyness (or wisdom) which keeps it well out of range of the muzzle-loaders of the natives.

The other two successful species, buffalo and elephant, have multiplied simply because they are large, dangerous animals, not easily tackled with muzzle-loaders. In a buffalo hunt in 1930 when, near the Kafue flats, a herd was driven, according to custom, into a selected swamp, the toll of dead was 30 buffalo and 7 of their native hunters. The amazing rapidity of the increase of this destructive species demands a planned effort at reducing their numbers and maintaining a constant check upon their increase. The same may be said about the elephant, of which there are at least 12,000 in Northern Rhodesia, and which are believed to have trebled in number during the past thirty years. Although there is no general excess, there are districts where the herds are rapidly becoming disturbingly large. The elephant must run no risk of extermination, but the cultivation and the works of man must also be considered. Based upon the rate of increase of the herds, which is estimated at 600 calves a year, Capt. Pitman suggests that control, exacting during the first three years up to a total of 800 individuals, could be organised in such a way that the herds of elephants at present roaming Northern Rhodesia would be shepherded into areas where there was the least chance of their interference with cultivation, and where their numbers could be kept at

the highest level consistent with the welfare of the human population. He is of opinion that, in spite of the low price of ivory (in April 1934 the local African price was 6*s*. 6*d*. per lb.), the control could be carried out by the Government with an excess of revenue over expenditure.

On the much debated question of the relationship between game and the survival of the tsetse fly, Capt. Pitman makes no pronouncement, but he notes that there is a tendency for this noxious carrier of sleeping-sickness (*Glossina morsitans*) to be carried from infected to fly-free areas by mechanical transport along the roads, and as regards game in the fly-belts themselves his conclusion is surely a sound one in the interests of both mankind and wild stock. "In a sparingly populated country like Northern Rhodesia, where 'fly' belts predominate, precluding the possibility of the natives keeping the necessary stock for their meat requirements, it is a duty to the indigenous population—in the absence of a 'fly' specific—to ensure the perpetuation of an adequate quantity of the wild animals from a dietetic point of view, if for no other; and to this end must native opinion be educated."

To strike a just balance between the various interests of mankind and the survival of wild game is no easy matter, and while regulations regarding game licences and the control of game in general, by protection or limited destruction, are essential and helpful, the safety of wild animals in the future is bound up with the establishment and efficient policing of game reserves and national sanctuaries in regions of sparse population, where the promise of native interference is slightest and of permanency greatest. J. R.

Back to Minkowski

Relativity:
an Elementary Explanation of the Space-Time Relations as established by Minkowski, and a Discussion of Gravitational Theory based thereon. By Dr. F. W. Lanchester. Pp. xiv+222. (London: Constable and Co., Ltd., 1935.) 12*s*. net.

DR. LANCHESTER, usually thought of in connexion with aerodynamics and motor engineering, has been interested in the theory of relativity since so far back as 1908, when he met Minkowski soon after the well-known pronouncement that "henceforth space by itself and time by itself will fade to mere shadows, and only a kind of union of the two will remain". The object of the present book is to reconstruct and develop the theory anew, following Minkowski rather than Einstein, and replacing advanced mathematical methods such as the tensor calculus by elementary geometry and algebra, illustrated by a large number of diagrams. On several topics, such as the velocity of light, space curvature, and the expansion of the universe, Dr. Lanchester differs from the usual conclusions.

Chapters i–iv, dealing with the restricted theory, call for little comment. In Chapter v it is argued that the phenomena of the pressure of light and the diffusion of matter by radiation compel us to reject the usual doctrine that the velocity of light in a vacuum is equal to the limiting velocity which can never be exceeded (that is, the *c* of the Lorentz formulae). Chapters vi–viii are described as an attempt to deal with gravitation on the basis of Minkowski's work. Planetary motion is treated by combining the Newtonian law of attraction with the FitzGerald contraction. The displacement of the Fraunhofer lines is deduced from the assumption that the time-rate of the 'solar chronometer' corresponds to that of an imaginary planet just skimming the sun's surface. This assumption gives half of Einstein's result. All that is claimed for this treatment of gravitation is that it gives results of the right kind and the right order of magnitude without making use of more than the most elementary algebraic expressions. It is acknowledged that space and time are dealt with separately, instead of together, and that the exposition lacks finality.

Chapters ix and x discuss some difficulties concerning the propagation of gravitation and the irregularities in the earth's rotation. In Chapter xii, the author disagrees with Einstein's principle of equivalence, which is considered as difficult to reconcile with the relativity theory of gravitation. It is suggested that the principle should be regarded as "no more than a scaffolding or temporary support, made use of by Einstein in the erection of his edifice, ultimately to be discarded". Chapters xi and xiii attack the theories of the expansion of the universe and general space-curvature. It is pointed out that

the apparent regression of the nebulae may be interpreted as a progressive diminution in the velocity of light. The author considers that "in the present state of knowledge he can find no reason or even excuse for postulating spherical space or any other of the imaginary forms proposed". Those who do so "are like those who in past times spent no less ingenuity in devising mechanical models of a hypothetical all-pervading medium which according to present-day philosophy has no existence". . . . "It may be that some day we shall wake, as from a dream, to find that things are not so different from what they seem after all."

The book concludes with twelve appendixes and an index. H. T. H. P.

Systematic Zoology

Dr. H. G. Bronns Klassen und Ordnungen des Tier-Reich wissenschaftlich dargestellt in Wort und Bild

(1) Band 5 : Arthropoda. Abt. 4 : Arachnoidea und kleinere ihnen nahegestellte Arthropodengruppen. Buch 4 : Solifuga, Palpigrada. Bearbeitet von C. Fr. Roewer. Lief. 1. Pp. 160. Lief. 2. Pp. 161–320. Lief. 3. Pp. 321–480. Lief. 4. Pp. 481–608. Lief. 5 (Schlusslieferung des 4 Buches). Pp. iv + 609–725. Lief. 1–5, 76.40 gold marks.

(2) Band 4 : Vermes. Abt. 2 : Aschelminthen. Buch 1 : Rotatorien, Gastrotrichen und Kinorhynchen. Bearbeitet von A. Remane. Lief. 2 (Rotatorien). Pp. 161–288. 16.80 gold marks. Lief. 3 (Rotatorien). Pp. 289–448. 18.80 gold marks. Lief. 4 (Rotatorien). Pp. 449–576. 16.80 gold marks.

(3) Band 3 : Mollusca. Abt. 3 : Bivalvia. Bearbeitet von F. Haas. Lief. 4. Pp. 385–544 und Nachtrag zum Schriftenverzeichnis. 23 gold marks.

(4) Band 3 : Mollusca (Weichtiere). Abt. 2 : Gastropoda. Buch 3 : Opisthobranchia. Bearbeitet von H. Hoffmann. Lief. 1. Pp. 152. 18.80 gold marks.

(Leipzig : Akademische Verlagsgesellschaft m.b.H., 1932–1934.)

(1) IN a monograph of 637 pages Prof. C. Fr. Roewer has assembled the information available in the literature on the Solifuga and has revised and extended this in the light of his observations on more than 2,500 specimens. The diagnosis of the order, a very brief history and a list of nearly 400 papers on Solifuga precede the account of the organisation, in which the external features are described in great detail, including the remarkable organs termed malleoli, situated on the coxa and the two proximal trochanters of the fourth leg, the function of which is still undetermined. The description of the internal organs occupies about fifty pages and is followed by a short account of the embryonic and post-embryonic development and by an interesting chapter of fifteen pages on the biology of Solifuga.

More than half the work (350 pp.) is devoted to the systematics of the order, which is subdivided into ten families and 138 genera, many of which are new. The distribution of the families is shown on a series of outline maps. A discussion of the phylogeny concludes by quoting Kästner's summary that, if the ancestral arachnid were *Limulus*-like, the scorpion is the oldest arachnid, but if the arachnids arose in the Tracheata the Solifuga must be regarded as the most primitive. A diagram is given showing the relations of the families to the Rhagodidae—regarded as the most primitive family.

The order Palpigrada, the first representative of which was discovered by Grassi fifty years ago, contains small, even minute, forms which vary in length from 0·8 mm. to 2·8 mm. The bibliography on this order consists of only about thirty papers. The external characters and the internal anatomy, of which the principal features are fairly well known, are described, but the embryonic development has not been investigated and little is known of the post-embryonic growth. The food is believed to consist of the contents of the eggs of *Japyx*, *Campodea* and *Pauropus*. The order has only the one family (Kœneniidae) established by Grassi, which contains four genera and twenty species. The Palpigrada are regarded as standing with the Solifuga, at the base of the arachnid stem, and the former present a greater number of archaic characters.

The volume has a general and a systematic index, and is well provided with dichotomous keys and with illustrations in line to demonstrate the principal systematic and structural features.

(2) These three parts on the Rotifera conform in method of treatment and in excellence of illustration to the high standard of the first part (see NATURE, 129, 743 ; 1932). In the present parts the account of the anatomy of rotifers is completed

and particular attention may be directed to the sections on the alimentary canal including the mastax, on the muscles, with some useful schematic figures, on the protonephridia and on the reproductive organs. The development is carefully considered. The classification used is a modification of that proposed in 1899 by Wesenberg-Lund; there are three orders—Seisonidea, Bdelloidea and Monogononta, the last of which is divided into three suborders—Ploima, Flosculariacea and Collothecacea. The systematic consideration of the genera follows. We look forward to the completion of this well-balanced account of an unusually interesting group of animals.

(3) The fourth part of the work on the Bivalvia is devoted to the further consideration of the shell and of pearls. The methods for distinguishing ordinary and culture pearls are described; for example, by examination under different forms of illumination and in a magnetic field, by their specific gravities and by investigation of the nucleus after boring halfway through the pearl. An interesting historical account of the culture of pearls follows. The author then proceeds to the description of the changes of the form of the shell during growth, the effect of the three-dimensional growth on the closing mechanism and the influence of varying conditions on shell-form, that is, the plasticity of the shell. A useful account is given of the variations in dimensions, weight, sculpture and periostracum of the shell and of the convergence in shell-form in different genera; for example, the shell-form characteristic of *Mytilus* is found in other genera, as in certain *Tridacna* and in *Driessena*. The work concludes with an additional list of nearly 900 titles of works on bivalves.

(4) The first part of the new volume on Opisthobranchia, with the exception of a definition, a concise statement of the principal external and internal features and an outline of the classification, is devoted to a bibliography extending to 150 pages and containing references to more than 3,000 works on this order of molluscs.

Gaza

Ancient Gaza, 4: Tell el Ajjūl

By Sir Flinders Petrie. Pp. vii+21+70 plates. (London: British School of Archæology in Egypt; Bernard Quaritch, Ltd., 1934.) 50*s*.

IN this volume Sir Flinders Petrie, following his usual and admirable practice of publishing the report on his work in the field with a minimum of delay, has given subscribers to the British School of Archæology in Egypt and archæologists in general a fully illustrated account of the material obtained by the expedition to Gaza (Tell el Ajjūl) in 1933–34. This season, the fourth spent on that site, was devoted to clearing about five acres of the Tell down to native rock, further work on the cemetery, and to drawing objects and preparing plans.

The area selected for excavation presented unexpected difficulties. Not only was it found to have suffered much from denudation, but also it had been used as a cemetery in the Hyksos period and for later burials. Further, the old land surface had been deeply cut by denudation before settlement began. Dating proved a complex matter, and so shallow were the deposits and in such separate patches that no continuity of stratification could be fixed. Dating by pottery, therefore, had to serve in linking up the area with palace levels. The most continuous course of stone basing of the walls is to be accepted as "representing the kind of civilization acquired during the xvth dynasty rule in Egypt".

What is perhaps the most remarkable feature of the season's results is the quantity of jewellery—gold, silver or electrum—recovered, not only in graves, but also in three hoards, evidently from their character old metal intended for melting up, which reflects the wanderings of a Syrian metal trader.

Two hundred and twenty weights were recorded, of which one third were surface finds. These bring the total of weights found at Gaza up to 448. The standards represented are Palestine, Babylonia, the West, Egypt, Syria, Persia, Phœnicia and an international gold beqa. The percentages of the standards indicate that Syria, with Persia and Babylonia, were far more influential in trade than Egypt. The small size of the weights is also remarkable.

Sir Flinders concludes his report with some general reflections evoked by the conclusion of his activities at Ajjūl owing to the change in the conditions of excavation imposed by the Antiquities Department. In consequence, the work of the School has now been transferred to Syria. In summarising the work that has been accomplished in eight seasons, he points out that these years have been more fruitful for the history of Egypt than any he has spent in the field, with the exception of those of the Naqada and Badari discoveries. Two dark ages of Egypt have been

explained by the invasion of people from the Caspian basin—the highly developed rock-workers of the seventh and eighth dynasties and the rude horsemen of the fifteenth and sixteenth dynasties. In the history of Palestine, instead of vague bronze and iron ages, dating has now been stabilised by scales of Egyptian dating and earlier sequence dates.

Further, it is pointed out, Gaza has revealed the more advanced work of a higher civilisation which was imported from foreign lands lying to the north. It has now become one of the problems of archæology in the Nearer East to investigate this unknown civilisation. The jewellery, of forms without parallel, imported to Gaza before 2000 B.C., invites further research. So Sir Flinders with indomitable spirit takes up the challenge and transfers his activities to Syria in the hope that he may be the pioneer in discovery here, as he has been elsewhere, and bring to light the origin of these previously unknown forms in what, he hopes, may prove to be the greatest culture of those ages.

Progress in Enzyme Study

Ergebnisse der Enzymforschung

Herausgegeben von F. F. Nord und R. Weidenhagen. Band 4. Pp. xii+391. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1935.) 31 gold marks.

THE subjects chosen for critical discussion in this, the fourth annual issue of 'enzyme progress', relate to more difficult and obscure sections of the field : it is perhaps all the more valuable to have them monographed.

As before, the contributors are from laboratories in many countries, and the contributions in three languages. T. Bersin of Marburg writes on thio-compounds and enzymes, to which attention has been particularly directed as the result of the work on the tripeptide, glutathione, which has the grouping $-CH_2SH$ in a side-chain, and takes part in a reversible biological oxidation-reduction system. There is evidence that the ferment papain is only active when it contains an SH group, and the same is true of urease. The relation of glutathione to the activity of several other enzymes is discussed.

That activation and inhibition of certain enzymes is brought about by definite chemical compounds is well known. In particular, activity is affected by hydrogen ion concentration ; oxidation-reduction potentials also seem to play a part. The existing knowledge of this subject for a number of specific enzymes is summarised by H. Tauber of New York.

The discussion as to the intermediate stages during the biological degradation of sugar is continued by O. Meyerhof of Heidelberg in regard to the formation both of lactic acid and alcohol respectively as end products. In both cases, sugar phosphoric acids appear in the early stages : the scheme of Embden seems to be finding general acceptance.

Information of a more exact character is accumulating in regard to the fermentation of the sugars by various bacteria which leads, in certain examples, to such products as propionic or butyric acids, to butyl alcohol or to methane. This section is written by A. J. Kluyver of Delft, who has managed to condense a good deal of information into some forty pages.

Somewhat novel is a contribution from Hungary by Bodmár and Barta on the enzymes of the tobacco leaf and the biochemical changes during the drying and fermentation of tobacco. This is essentially an operation which should be under biochemical control, and its fuller understanding will undoubtedly be of interest to what is largely an empirical industry.

A second section of industrial application is that by Albert Hesse of Munich on enzymes in the bakery, in which the newer work is elaborated. The differences in the wheat flours of the various countries and the variations in the national requirements in regard to the nature of the loaf make international comparisons and deductions in this subject impossible. Baking is another example of an industry which is still largely empirical, and so has much to learn from biochemical science.

The only section in French is by Maurice Beau of Paris ; it deals with rennet and the coagulation of milk. Considering its importance, milk has been much neglected by the biochemist, and there is all to learn about its proteins and minor components. The work is, of course, of extreme difficulty both experimentally and in regard to its interpretation. One phase of it, that of lactoflavin—which is possibly vitamin B_2—is elaborated here by Wagner-Jauregg of Heidelberg, who has been associated with Kuhn in much of his most brilliant work in this subject. This has enabled both the determination of the constitution of

lactoflavin and the synthesis of what is probably a stereoisomeric colouring matter from *l*-arabinose.

The final section, contributed from Princeton by E. Newton Harvey, deals with a novel subject, namely luciferase, which is an enzyme concerned in the luminescence of living organisms.

The editors and authors are once more to be congratulated on the production of a volume which will be found both stimulating and helpful to all workers in these particular fields of inquiry.

E. F. A.

An Introduction to Structural Theory and Design: Theory

By Prof. H. Sutherland and Prof. H. L. Bowman. Second edition. Pp. xi+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17*s*. 6*d*. net.

SINCE its original publication about five years ago, this work has proved itself a very valuable introduction to the basic conceptions and principles of structural theory as related to trusses, rigid frames and space frameworks, and has asserted itself as a trustworthy book of reference. In preparing the second edition, the authors have taken this opportunity to effect some revision, particularly in enlarging the section on moment distribution and in adding one on the column analogy for rigid frame analysis.

On the whole, however, the book follows the same lines as its predecessor in treating, very conscientiously and with a wise insistence on the value of simple proofs and direct solutions, the stress analysis of the wide range of structures included in its purview. It is particularly rich in the explanations given of the numerous direct and indirect methods of analysis which are available and, while its purpose is to interpret as fully as possible the introductory theory of structures, this is illustrated by numerous worked examples showing how, in practice, the actual processes, be they graphical or analytical, are carried out. With the many further problems suggested for analysis, the work could be used to great advantage for class or private study. At the same time, the clear-cut subdivision of the matter, the finality with which each method is treated and the practical outlook of the authors make it within its limits an eminently useful book for those professionally engaged in structural work.

J. A. C.

Electrical Water Heating: with Special Reference to the Domestic Storage Heater

By D. J. Bolton, Philip C. Honey and N. S. Richardson. Pp. viii+192. (London: Chapman and Hall, Ltd., 1935.) 7*s*. 6*d*. net.

THIS book deals with both the scientific and the commercial aspects of electrical water heating. It naturally falls into three main divisions: the first one is concerned with the construction of domestic storage heaters of various types, and the method of fixing and fitting them in the house; the second with the hot water systems at present in ordinary domestic use; and the last with the supply and consumption of electricity commercially.

There is a good description of the control of the temperature of electric heaters by the bi-metallic type of thermostat. In this, the differential expansion of invar and brass is employed to give the necessary change of length, and the method of enclosing such thermo-regulators in the cylindrical water-storage tanks is discussed in considerable detail. Various methods of grafting such an electrical system on to the existing hot-water circuit of the house are also included, and the several factors which affect the price of electricity as sold to the consumer are set out clearly. This book should prove of service to electrical engineers who are concerned with the problem of water heating, as well as to architects who are preparing to design the houses of the future.

Die Harze:

die botanischen und chemischen Grundlagen unserer Kenntnisse über die Bildung, die Entwicklung und die Zusammensetzung der pflanzlichen Exkrete. Bearbeitet von A. Tschirch und Erich Stock. Dritte umgearbeitete Auflage von A. Tschirch: Die Harze und die Harzbehälter, Band 2, Hälfte 1. Pp. xii+471. (Berlin: Gebrüder Borntraeger, 1935.) 48 gold marks.

WE have already noticed (March 31, 1934, p. 478) the first portion of this monumental work, which dealt in general with the resins. There has now been issued the first half of the special part describing in detail the individual resins. Those chosen are classified as the ester or benzoic resins, commonly termed balsams, and the bitter resins such as myrrh, elemi, etc. The information, covering a very great deal besides botany and chemistry, is of the fullest, and there are copious illustrations, both botanical and otherwise, including pictures of the original packages in which the resins are shipped as well as maps. We know of no other similar subject which has been monographed so exhaustively.

Der Chemie-Ingenieur:

ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob. Generalregister für Band 1–2. Pp. ii+99. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 8.80 gold marks.

THIS small volume, which is uniform in type and binding with the eight parts of "Der Chemie Ingenieur", consists of a general classification of the subjects treated in these books and provides a rapid means of discovering in which part a particular detail of the general subject is discussed. It thus prevents one having to examine the tables of contents at the end of each part until that part in which is the particular section of the subject required is found. The general index will therefore greatly facilitate reference to the contents of these eight books, and the authors are to be congratulated on completing their labours in such a thorough manner.

Polymerisation and Condensation Reactions

AT the meeting of the Faraday Society held on September 26–28 at Cambridge under the presidency of Mr. W. Rintoul, the subject of polymerisation and condensation reactions was discussed.

The technical development of the manufacture of the group of substances known as plastics, resins and moulding powders is now attaining large dimensions, and it occurred to the Colloid Committee of the Faraday Society that academic interest in these substances might be stimulated by such a meeting. In this it was not mistaken. Whilst the Faraday discussions have always been somewhat international in character, this meeting was favoured by the attendance of an unusual number of both members and visitors who came from overseas.

We are indebted in the first instance to Staudinger for emphasising the now generally accepted view that the polymers and condensates must be regarded as constituted of macromolecules formed by the polymerisation or condensation of single units. Both the physical and chemical properties of the finished materials should be capable of interpretation on this basis.

We now recognise three different types of macromolecules : the linear, which can be written $A(A)_nA$ or $(AB)_n$; the large ring or closed type ; and the cross-linked variety. This latter in its simplest form might be regarded as a system of linear macromolecules linked together by cross-linkages like the rungs on a ladder, and in its most complex state as a crystal like silica.

Amongst a number of important and interesting topics three attracted most attention : the mechanism of growth of the large molecules from the small ones ; the information yielded by X-ray examination of the substances, especially when stressed ; and the relationship between the mechanical and physical properties on one hand, and on the other the chemical structure of the material.

The discussion made it clear that there must be a number of different mechanisms by which macromolecules can be formed. For example, in the formation of a macromolecular ester from a dibasic acid and a dihydric alcohol, the chemical reaction involved, namely, the esterification process, would appear to be energetically identical both for commencing and for propagation of the chain. On the other hand, in the polymerisation of a substance like styrene, the energetics of commencement and propagation are widely different. Once the growth has been initiated by the formation of what may be termed, to borrow from the nomenclature of chain reactions, a reaction centre, the chain propagation proceeds relatively rapidly.

During the course of the meeting, it became clear that a number of new factors not operative in the ordinary gaseous chain reaction must be considered in the growth of the macromolecule. For example, it is evident that in different systems the length of the macromolecule is subject to wide variation. In the case of many olefine polymerisation processes the mean length of the macromolecule corresponds to the dimer ; in the case of the acrylic acid the length can certainly exceed ten thousand of the monomeric units. At present, it is difficult to elucidate the reason for this wide variation in chain length. It seems possible, at least in the olefines, that ring closure to form a cyclic compound, which can, of course, open again, plays an important part in retarding the growth of the chain. In the drying oils a steric factor appears to be important ; the polymer must thus be regarded in its undistorted form as spherical rather than thread-like. Both in the polymerisation of acetylene and in the case of formaldehyde, it seems certain that chain termination is brought about by a special type of collision of the growing end of the chain with a monomer, the terminating collision differing from the propagating collision both in the energy and the number of degrees of freedom involved.

One interesting feature of many of these reactions is the relatively rapid growth of the chain after initiation. It seems unlikely that this can take place through the ordinary collision mechanism, for the rate of diffusion of the monomer to the active centre at the end of the growing chain would then govern the reaction velocity ; the energy of activation of the controlling process is known to be low, of the order of 5 kgm. cal. The suggestion was advanced that monomeric molecules might be supplied to the growing end of the chain by travelling along the chain. On this view, the process of chain growth must be regarded as analogous to the growth of crystals such as hydroquinone, where diffusion over the crystal surface plays a large part in controlling the rate of reaction.

Finally, it is well known that a macromolecule such as polystyrene can be decomposed into simple units by heat, and indeed at relatively low temperatures ; the same appears to be true for

the polymeric forms of formaldehyde, but many similar polymers are not so readily reversibly decomposed and require really high temperatures to bring about thermal destruction, from the products of which the monomer can be isolated. It is significant in this connexion that the pyrolysis of straight chain hydrocarbons proceeds more readily the longer the chain.

The chain-like structure of the cellobiose polymer cellulose and the more complicated polypeptide chain found in the proteins has been confirmed in a satisfactory manner by X-ray examination. These systems are, of course, quite distinct from the ordinary crystal in that the series of parallel chains along which the composition and structure are subject to repetition are usually so long that it is impossible to identify the relatively small elementary cell as determined by X-ray examination with a definite number of macromolecules. The molecules are much longer than the elementary cell and the X-ray pattern obtained is a fibre diagram.

A number of polymers like the polyoxymethylenes exhibit a crystalline pattern ; others like the phenol formaldehyde complexes only give an amorphous pattern ; whilst a third and most interesting group give an amorphous pattern in their natural state but a crystalline pattern when stretched, these including rubber, polyvinyl alcohol, sulphur and polyethylene tetrasulphide. All these substances when stretched exhibit over a suitable range of temperature the remarkable extensibility shown by natural rubber. It is difficult to avoid the conclusion that great extensibility is associated with very long macromolecules, which are sufficiently flexible and at the same time mobile under stress to permit of orientation in parallel threads by the simple application of tension.

There are obvious difficulties to be overcome if this simple hypothesis be accepted as correct. On stretching rubber and freezing it, its fibre diagram and extension are both preserved ; on warming, both extension and fibre diagram disappear, a process analogous to the melting of a solid. In a collection of small rod-shaped molecules in the liquid form, thermal agitation will ensure that the molecules are in complete disorder ; but as the molecules grow longer the Van der Waals' forces of cohesion increase and the tendency for bundles or clusters of molecules to be formed with a common axis of orientation increases, a phenomenon termed cybotaxis. We might have anticipated unstretched rubber to be a cybotactic fluid *par excellence*. It is possible that this is really the case, but that the microclusters which are themselves in disorder are too small to be revealed by the X-rays. The thermal changes associated with the stretching of rubber give us a measure of the heat of adsorption of the polyprene chains on a polyprene surface.

The most important property of macromolecular polymers is that they alone amongst organic materials manifest to a significant degree such mechanical properties as strength, elasticity, toughness, pliability and hardness. Well oriented and fibrous polymers such as natural cellulose and silk are, weight for weight, stronger than iron. Synthetic polymers are not so strong as these natural products, and a good deal of attention has naturally been devoted to the problem of calculating the maximum tensile strength possible in a polymeric material and the cause of the relatively low values obtained. The following figures for the tensile strength in kgm. mm.$^{-2}$ for various materials at 20° C. are interesting :

Best spring steel	197	Iron	20
Flax	100	Glass	5
Rubber	80	Polystyrene	4
Silk	35	Urea formaldehyde	3
Wool	28	Asphalt	1×10^{-2}
Artificial silk	25		

Calculations from the form of the Morse potential curve show that a tensile strength of no less than 2,000 kgm./mm.^{2} would be obtained for a completely orientated and fibrous rod composed of a bundle of macromolecules the individual lengths of which are equal to that of the rod. There seems little reason to doubt that materials stronger than the best steel should be capable of being made.

Another interesting property peculiar to these polymers is their extensibility or swelling in various solvents. Linear or chain-like polymers may be prepared which undergo simple solution in appropriate solvents.

As the chain length of the macromolecules increases, the process of molecular solution commences due to solvent imbition and swelling of the solid ; this is followed by the formation of aggregates or micelles. These micelles are eventually dispersed to the molecular form on further appropriate dilution of the solution. On the other hand, cross-linked polymers such as silica or vulcanised rubber or phenol formaldehyde resins do not swell or disperse in solvents.

Staudinger has prepared a most interesting series of products from polystyrene, exhibiting all the transition stages. Polystyrene consists of simple thread-like macromolecules which will go into true solution in organic solvents ; the process of solution as we have noted being preceded by solvent imbition and swelling. If, however, to the styrene a small quantity of *p*-divinylbenzene be added before polymerisation, then when the chains are formed molecules of this material are incorporated in the growing chain and cross-

linkages come into existence by the formation of divinylbenzene bridges. Such a cross-linked system is no longer dispersible in solvents, although if not too many cross-linkages are formed the material is capable of swelling. If the ratio of styrene to divinylbenzene is as high as 50,000 to 1, the product is highly extensible but insoluble, whilst if it be as low as 1,000 to 1 the product shows scarcely any sign of swelling at all.

It is clear that the properties of the polymers and condensation products may be altered to a most extraordinary extent by the addition of suitable materials even in subanalytical amounts.

ERIC K. RIDEAL.

Maintenance of Life in Isolated Animal Organs

THE preliminary announcement of the work of Carrel and Lindberg on the maintenance of life in isolated organs, to which reference has already been made in our columns[1], can now be amplified with further details of their method, from which an idea can be obtained of how the difficulties involved have been surmounted[2]. The organs are removed with complete aseptic and antiseptic precautions from an animal that has just been killed by bleeding under anæsthesia ; adult cats or fowls are generally used. With the organ are removed the surrounding tissues, arteries, veins, nerves and lymph vessels : for example, in the case of the ovary, with the organ itself are removed the Fallopian tube, and a flap of peritoneum and connective tissue containing the ovarian artery. During the operation the abdominal cavity and the organ are protected with gauze pads soaked in Dakin's solution.

The organ is introduced into the culture chamber protected by a sheet of 'cellophane' and the artery is connected with the cannula of the apparatus ; the chamber is closed by a rubber stopper and sealed with a cellulose acetate cement. A sterile pulsating circulation is maintained through the organ by the apparatus ; different culture media have been used for this purpose. In order that the supply of glucose and bicarbonate may be sufficient for several days, the volume of the medium must be about 2,000 times greater than that of the tissues. For example, a cat's thyroid which weighs 85–110 mgm. requires about 230 c.c. of fluid. The apparatus may be used with 200–900 c.c. of medium. The latter may be blood-serum, diluted with Tyrode's solution, and containing sometimes hæmoglobin, or an artificial growth-activating solution, containing protein-split products, hæmin, cysteine, insulin, thyroxine, glutathione, vitamins A and C, blood-serum, etc. A small amount of phenol red must be added, as indicator of the metabolic activity of the organ, as well as of the occurrence of bacterial infection. The medium is under an atmosphere of 40 per cent oxygen and 3–4 per cent carbon dioxide, the remainder being nitrogen, and is kept well aerated.

The apparatus is kept in an incubator at 37°–38° C. and is so designed that the organ and perfusion fluid can be continuously observed. The circulation is started about an hour after the death of the animal ; the number of pulsations is usually about 60 per minute, the systolic pressure being 120 mm. mercury and the diastolic 60 mm. mercury. Rate and pressure can be varied at will.

The organs used in the apparatus so far have been the thyroid gland, the ovary, the suprarenal gland, the spleen, heart and kidney. In the case of the thyroid, three different media have been used as perfusion fluids ; with diluted serum or an artificial medium containing amino-acids, the volume of the gland decreased and the follicles remained full of colloid, even after twenty-one days. With the medium containing peptones the glands grew and doubled their weight in three to four days ; the consumption of sugar was increased more than three times. Histologically, there were observed either a disordered epithelial proliferation with disappearance of the colloid or an increase in the volume of the cells and in the number of follicles, with production of colloid. In an experiment with an ovary perfused with a growth-promoting medium, the weight of the organ increased from 90 mgm. to 284 mgm. in five days and three corpora lutea developed. Growth was, however, accompanied by disorganisation ; there was a luxuriant and disordered proliferation of the stroma and of the epithelial cells.

These experiments show that an entire organ can be kept alive *in vitro*, increasing in size and weight, due to the appearance of new cells and tissues. The method should have great value in the study of different organs, especially those having an 'internal secretion', and further reports by Carrel and Lindberg will be awaited with interest. If it is permissible to speculate about the future, will it be possible for the chemist to utilise isolated perfused organs for the manufacture of their specific secretions in unlimited quantities, in cases in which a chemical synthesis is difficult or has not yet been achieved ?

[1] NATURE, **135**, 1066 ; 1935.
[2] *Science*, 621, June 21, 1935. *C.R. Acad. Sci.*, 14, July 1, 1935.

Recent Antarctic Research

undertaken by the Discovery Committee

THE R.R.S. *Discovery II*, 1933-35

By Dr. N. A. Mackintosh

THE R.R.S. *Discovery II* returned to England at the end of her third commission in June this year. During the twenty months she was away, her work included an examination of the whale population and its environment in the vicinity of the Atlantic and Pacific ice edge; repeated observations on a particular meridian for the study of seasonal variations; some repetition and consolidation of observations taken in previous commissions; a survey of the South Shetland Islands and, on the homeward voyage, a new line of stations running parallel to the East African coast from Marion Island in 47° S. to the Gulf of Aden. Throughout the commission, routine soundings were taken with the echo-sounding machines. The route taken by the ship on her various cruises is indicated in Fig. 1.

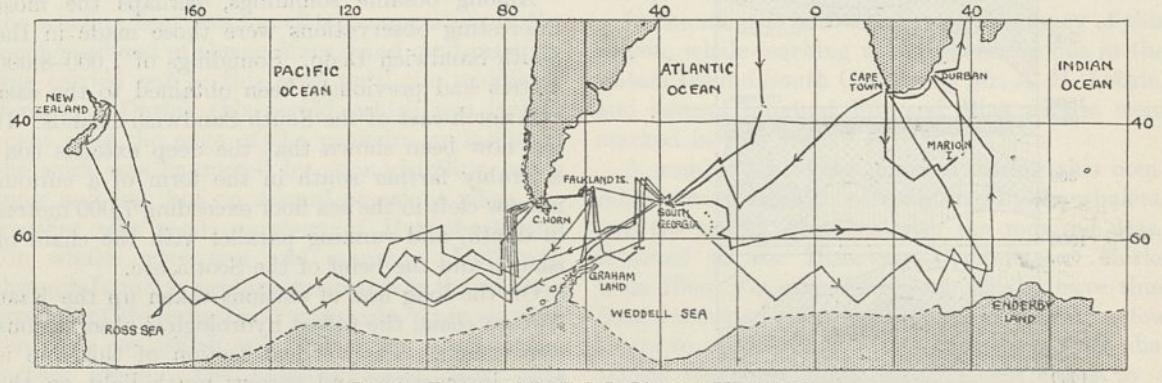

FIG. 1. Voyages of the R.R.S. *Discovery II*, 1933-35.

Several years will, of course, be required for a proper examination of the material and data collected, but certain interesting points have already arisen and may be briefly described here.

During several long cruises, in which a zigzag course was followed to the north of the pack ice, direct and continuous observations on whales were combined with routine observations on plankton and hydrology. These observations provide material for comparing the abundance of whales in the Pacific and Atlantic sectors of the Antarctic, and an important correlation has been observed between the distribution of whales and the surface temperature of the water. It is anticipated that the most important results of the commission's work will in due course be derived from these cruises off the ice edge.

The section of the work which may be said to have yielded the quickest results was that in which a line of stations on the meridian of 80° W. was repeated in December, March, September, October and November. Each line included from seven to ten stations at intervals of about 90 miles, and in each case the southernmost station was at the edge of the pack ice. The routine at each station included a series of six vertical hauls with closing 70-cm. plankton nets from various depths between 1,000 metres and the surface. A preliminary examination of the samples from these nets reveals a large-scale migration of the plankton which is likely to be of far-reaching importance.

It is known that in the Antarctic zone there is a thin layer of cold Antarctic surface water which moves with a northerly component away from the ice. Below this is the so-called warm deep water flowing south, and below this again the cold Antarctic bottom water which moves northwards. Fig. 2 shows six vertical sections of the line in 80° W. The first shows diagrammatically the circulation of the surface water and the warm deep water. The other five show the newly ascertained distribution of the copepod *Rhincalanus gigas* in the various months in which the line was repeated. They are drawn quite roughly and may need adjustment when the material is examined in more detail. In December (summer) the species is mainly concentrated near the surface. In March it tends to sink to the north of the Antarctic convergence. In September (winter) it is practically confined to the warm deep water, and in October and November (spring) it has largely regained the Antarctic surface water. Similar seasonal changes in level have been

observed in several other species which, together with *R. gigas*, make up the bulk of the Antarctic macroplankton, but these do not appear to include the Crustacean, *Euphausia superba*, which constitutes the food of the Blue and Fin whales. To those who have studied the plankton of the Southern Ocean, it has for long been a problem to understand how organisms drifting in the surface water are not all carried northward into warmer latitudes where they could not be expected to survive. The stations worked by the *Discovery II* in 80° W. have provided material

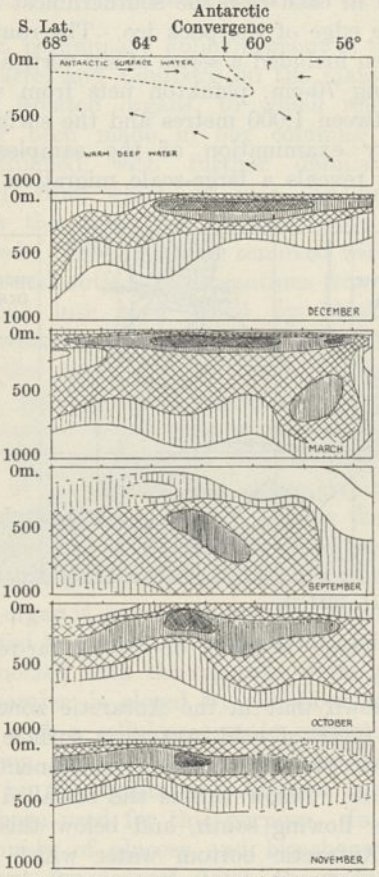

FIG. 2. Seasonal changes in the vertical distribution of the Copepod *Rhincalanus gigas* on the meridian of 80° W.

from the consideration of which a very substantial contribution can be made towards the solution of this problem. It appears certain that at least a considerable number of the species are carried northwards in summer in the north-flowing surface water, and return south again in winter in the southgoing stream at depths of at least 400 m. It is believed that such a large-scale circulation of the plankton, extending over some hundreds of miles of latitude, has not hitherto been demonstrated in any part of the world.

Among the new devices which were successfully used during this commission mention may be made of the Harvey phytoplankton net and the echo-sounding recorder. The former is an apparatus designed by Mr. F. W. Harvey of Plymouth[1]. Samples of phytoplankton are treated with acetone, and the amount of chlorophyll extracted is measured by comparison with a series of colour standards. This method is a great improvement on any hitherto used for estimating the relative abundance of phytoplankton in different localities. The apparatus was used at almost every station throughout the commission. With the echo-sounding recorder, the echo from the sea floor, produced by the ordinary deep-sea hammer, is picked up by a microphone and automatically marked on a moving scroll of paper. On this the contour of the bottom is traced out as a continuous line. It is most effective in shallow water and in places where rapid changes in depth occur, and it was in continual use during the surveying of the South Shetland Islands.

Among oceanic soundings, perhaps the most interesting observations were those made in the South Sandwich Deep. Soundings of 7,000–8,000 metres had previously been obtained to the east and north-east of the South Sandwich Islands. It has now been shown that the deep extends considerably farther south in the form of a curious narrow cleft in the sea floor exceeding 7,000 metres in depth, and running parallel with the chain of islands and the bend of the Scotia arc.

On the long line of stations taken up the East African coast, the fullest hydrological observations were made. The vertical section of this line is most instructive, and throws much light on the major current systems of the Indian Ocean. Large closing nets fished in deep water on the same line produced abundant material of biological interest.

During this commission the ship was under the executive command of Lieut. A. L. Nelson, R.N.R.

[1] *J. Mar. Biol. Assoc.*, **9**, 2, 761; 1934.

THE R.R.S. *William Scoresby*, 1934-35

By G. W. Rayner

The Discovery Committee's vessel, the R.R.S. *William Scoresby*, completed in May this year her fourth commission—a short one of seven months devoted entirely to the marking of whales on the whaling grounds in the Antarctic seas off Queen Mary Land, off Enderby Land and to the south of Bouvet Island. The ship sailed from London on October 16, 1934, and made a direct passage to Simonstown, where final preparations for the work in hand were completed. The ship's personnel, under the executive command of Lieut.-Comdr. C. R. U. Boothby, R.N.R., included an experienced Norwegian whale gunner, Capt. J. Endresen, who had charge of the manœuvring of the vessel whilst

hunting and marking whales. The pack ice was encountered on December 3 when seven days out from Cape Town. Whales had been found on December 1 and marking began on that date.

The R.R.S. *William Scoresby* is an oil-burning steam vessel, and arrangements had been made for supplies of fuel oil from the whaling factory ships operating in the neighbourhood. On reaching the pack ice the vessel turned eastwards along its edge, and a few days later ships of the whaling fleet were heard in wireless communication with each other. When fuel oil was required, the vessel was enabled to find the desired factory ship by wireless bearings. She went alongside the factory ships in the same manner as the catchers go alongside for fuel—that is, with a floating whale carcase between the two ships to act as a fender. This manœuvre was carried out, in the open ocean, on eight occasions.

At the beginning of the season, the majority of the whaling fleet was found to be operating in the neighbourhood of Queen Mary Land, and marking was carried out in this area until the middle of January. During this period, which was largely spent near the edge of the pack ice or inside it, the work was hampered by poor visibility, much snow and fog, but on several occasions when the weather was good, numbers of Humpback and Fin whales were met and marked. Half way through January, a return westwards to the whaling grounds of Enderby Land was made, again skirting the pack ice which was now lying considerably farther south. Off Enderby Land, work was carried on in the open ocean and the pack ice was not again encountered during the remainder of the season. From this time until almost the end of the season, the weather was good and both Blue and Fin whales were usually to be found, sometimes in large numbers. Fin whales are to be met with at this time of the year in bodies numbering as many as fifty to a hundred and, on occasions, two such bodies were found in the course of a single day. When this occurred it was possible to mark between forty and fifty in the long daylight hours.

One month was spent in the waters off Enderby Land, and in March the ship moved westwards to the south of Bouvet Island. In the middle of March course was laid for the Cape, which was reached on March 29 after 122 days at sea without sighting land of any kind. During this time between seven and eight hundred whales—Blue, Fin, Humpback and Sperm—had been marked.

When opportunity offered, during bad weather or dark hours, water and plankton samples were taken and, for a few days in February, when in wireless communication with the R.R.S. *Discovery II*, the *William Scoresby* was able to co-operate to a small extent in her programme of hydrographic and plankton research.

In the months of December and January of this season, whale-marking was also carried out in the waters around South Georgia by Mr. A. H. Laurie, and several hundred Fin and Blue whales were marked in this area.

A number of whales marked during this commission have already been captured by the whalers, and the marks, together with the required data, returned to the Discovery Committee. Marks from Blue, Fin and Humpback whales have thus been recovered after periods varying from a few hours to three and a half months; and the distances traversed range from a few miles to a thousand miles. The data thus obtained are extremely instructive in showing the trend of movement of the whale stock on these grounds during the course of the season, but more valuable results are to be expected from marks returned during next whaling season.

National Food Policy

British Association Discussion on Economics of Diet

THE discussion on the economics of diet before Sections F and I (Economics and Physiology) at the recent Norwich meeting of the British Association, and the resolution on nutrition at the present assembly of the League of Nations has emphasised the interdependence of problems of public health, agriculture and economics. This interdependence has become evident in the last few years of trade depression when attempts, which are not very successful, are being made to deal with the problems of these subjects separately. It is now being realised that they must be considered together in the light of the international position.

The world economic crisis paralysed international trade in foodstuffs as well as in other commodities. But agricultural production cannot be cut down so quickly as industrial factory production. Consequently stores of foodstuffs accumulated and prices fell.

The first reaction was an attempt to control production, limit imports and regulate marketing

with the object of raising prices. It was thought that when wholesale prices of foodstuffs rose, the purchasing power of primary producers for industrial commodities would be increased and general prosperity would return with an all-round rise in prices.

A different view is that low prices for agricultural products are the result rather than the cause of trade depression. Under-consumption, due to low purchasing power of the people in the industrial centres where depression is worse than in agriculture, is a more potent factor than over-production. Hence raising prices by reducing production and regulating the markets will lead to a further lowering of consumption, with the 'glut' appearing at a still lower level of consumption, a still further restriction in trade, and in addition, an increase in malnutrition due to a worsening of the diet of the poorer classes of the community. Those who approach the problem from this angle wish to find a solution of our problems in increased consumption rather than in controlled production.

The crux of the difficulty is how to initiate the desired increased consumption. One of the speakers at the British Association suggested that a beginning should be made with food. The present Agricultural Marketing Boards should be replaced by public utility companies which would run the processing centres ; for example, centralised slaughter-houses, bacon factories, wholesale milk depots, through which products must pass from the farm to the consumer. These Boards would buy from the farmer and sell to the distributing trade. The gulf between what the farmer would get and what the consumer is asked to pay would be bridged by a direct subsidy from the State, paid to these Boards.

There would be no control of retail prices, because the services of distribution vary so widely in different classes. But the Boards, either themselves or by arrangement with distributors, would make the staple foodstuffs available at a price within the reach of the poorest. They would be available without tickets and irrespective of class, to all who would be willing to collect food from the depots or shops, and so save the cost of distribution which, in the case of some foodstuffs, for example, milk, is about half the retail price.

With the subsidy and this saving in the cost of distribution for those who care to take advantage of it, a diet adequate for health would be within the reach of the poorest. It was suggested that the result would be a reduction in preventible disease which, within a reasonable time, would effect savings in the cost of public health services which would go far to offset the cost of subsidising increased consumption. In addition to ultimate savings arising from improvement in health, there would be an immediate saving in the cost of complicated public health measures such as free meals and cheap milk for school children, and the issue of dried milk free or at reduced prices at child welfare centres. These measures with their taint of pauperism would be no longer necessary.

The results of a preliminary inquiry seemed to indicate that there may be as many as twenty million of the population whose health would be improved by an increased consumption of the more expensive foodstuffs such as fruit, vegetables, milk and animal products, and an examination of family food budgets and family incomes showed that price was the limiting factor for the consumption of these. If consumption were increased to a level at which every member of the community had a diet adequate for health, there would be room for a considerable expansion of agriculture in Great Britain without decreasing imports.

To initiate a national food policy on these lines, however, requires a Government subsidy, and subsidies are unpopular. It is argued, however, that the subsidy, in addition to making agriculture remunerative, would irrigate the field of internal trade, stimulate industries, and flow back again to the Treasury in increased income tax and other receipts.

On the same day as the discussion at Norwich, twelve countries, including Great Britain, France and Italy, submitted to the Assembly of the League of Nations a resolution stating that "the relationship of nutrition to the health of the people has become a social and economic problem of widely accepted significance", and that "this subject has an important bearing on world agricultural problems". The League has approved an inquiry into the whole question.

The discussion at the British Association and at the League of Nations has aroused sufficient interest to ensure that there will be a fuller inquiry. It is probable that we may be working towards a national food policy into which both agriculture and public health interests can be fitted and reconciled. But as one of the speakers at the British Association urged, we need far more information than is available before a food policy can be elaborated. It is in the public interest that such an inquiry should be instituted to ascertain :

What is the amount of increased consumption required to provide an adequate diet for every member of the community ?

To what extent can health be improved by increased consumption of certain foodstuffs ?

What effect would increased consumption have on British agriculture and on trade ?

What economic and financial measures are required to initiate and promote increased consumption ?

There is obviously a wide field of inquiry in which different Government departments should co-operate. A halt should be called to planning according to preconceived theories. We need far more information than is available before any more marketing schemes affecting the food supply of the country are brought into being.

Obituary

Sir John McLennan, K.B.E., F.R.S.

THE great Exhibition, held in 1851, resulted in a large profit which was well invested, and the income has for many years been awarded as scholarships to research students. The results prove that it was one of the best investments ever made. John Cunningham McLennan, among many other men ultimately distinguished in science, received such an award, and it enabled him to join the Cavendish Laboratory at Cambridge from his home in Ontario after his graduation at the University of Toronto. Under the guidance of Sir J. J. Thomson, the Cavendish was enjoying a burst of discovery in connexion with the electron and the ionisation of gases. Young McLennan quickly caught fire, and on his return to Toronto as a demonstrator in physics, at the age of thirty-two, he published a paper in the *Transactions of the Royal Society* (**195**, 1899) in which he proved that the ionisation of gases due to electrons in motion was similar in type to that due to Röntgen rays or the radiations from uranium.

At the same time that Rutherford and H. L. Cooke at McGill were discovering the penetrating radiation, supposedly and mainly from the radioactive substances in the ground, McLennan and E. F. Burton were finding, independently, similar results at Toronto. The later expansion of this subject into cosmic radiation was not then suspected. McLennan also carried out many experiments on the 'natural ionisation' in closed vessels, tracing the effects to minute quantities of radioactive materials, such as polonium in the walls, or radon in the enclosed air. By exposing sealed ionisation electroscopes over the ice on Lake Ontario, he definitely proved that the penetrating radiation over land was greater than over water, and this showed that a large part of the penetrating radiation came from the radium which Lord Rayleigh proved to be widely distributed in small quantities throughout primary and secondary rocks and sediments.

With immense energy, McLennan worked with others to raise funds for building that great physical laboratory at the University of Toronto which now so happily bears his name. Moreover, he secured abundant equipment with excellent apparatus especially for spectroscopy. One of his early successes was the discovery of the single line spectra of zinc, cadmium and magnesium and the deduction of their ionisation potentials. This was a sequel to the work of Frank and Hertz, who had obtained the single line spectrum for mercury. Electrons projected with low voltages in a discharge tube will excite a single line, but at a higher critical voltage the usual many-lined spectra appear.

During the War, McLennan came to England and took an intensely active part in the research work of the Admiralty in connexion with the anti-submarine campaign. His view was that a professor was co-equal in rank with an admiral, and he reported directly to the First Sea Lord. Thus, in certain magnetic work, he insisted on the speedy isolation of a submarine in a dock at Portsmouth with a view to a magnetic survey and the determination of its magnetic moment, hitherto an unknown quantity. At the same time, he organised the extraction of helium from natural gases near Calgary, and obtained a considerable quantity intended for airships and balloons, but actually used after the War for experimental purposes. During the greater part of 1919 he was scientific adviser to the Admiralty.

After the War, McLennan returned to Toronto and continued with enthusiasm and success his work on spectroscopy, for which he was awarded a Royal Medal of the Royal Society in 1927, and the following year he had the honour of giving the Bakerian Lecture to the Society on "The Aurora and its Spectrum". The brilliancy of the aurora is shown by the spectroscope to be due to nitrogen, and the lower limit of the height of the discharge has been proved by Størmer to be about eighty miles above the earth's surface. On any clear night it had been proved by Lord Rayleigh, Vegard and others that there is also present in the spectrum a notable green line (5377) the cause of which gave rise to much controversy. In the Bakerian Lecture (*Proc. Roy. Soc.*, A, **120**, 1928) McLennan described how he and G. M. Shrum had proved in the laboratory that the green line was due to *oxygen*, suitably mixed with argon, which when in a metastable state, as Frank had shown in similar cases, is capable of transferring its energy to a different type of gas.

McLennan next determined with characteristic energy to instal at Toronto a cryogenic laboratory capable of liquefying air, hydrogen and helium. In this difficult undertaking he received advice and plans from Onnes at Leyden and financial support from the National Research Council of Canada, and

the scheme was quickly brought to a successful issue, so that new avenues of research work were opened to his numerous students. The relations between supra-conductivity and magnetism both in elements and alloys were investigated, and such work is continuing under the able guidance of E. F. Burton, who succeeded McLennan on his retirement three years ago.

Prof. H. E. Armstrong wrote to *The Times* on October 12: "In McLennan we lost no mere scientific worker, but a man of the most admirable social gifts, indeed a man to fall in love with. It was a sight for the gods to see him beam with enthusiasm and joy, in his Royal Institution lecture, at his helium super-cooled ring in which the current put into it in Leyden in the afternoon continued to circulate. He had nursed it over from Holland by air."

In the *Proceedings of the Royal Society*, McLennan wrote more than fifty papers, in forty of which his research students collaborated. Perhaps it would not be invidious to name those who contributed two or more papers—D. S. Ainslie, H. J. C. Ireton, H. Grayson-Smith, A. B. McLay, A. R. McLeod, G. M. Shrum. All this work, carried out at high pressure, sometimes led to stress and strain, and McLennan was always impatient with fools—sometimes with others—and though he could not suffer them gladly, his kindly, friendly nature usually restored sunshine after storm. He was a man who thought, spoke, wrote and lectured very clearly, and he was insistent on essential things. He was of a composite nature, greatly preferring friendship, but quite ready for a fight, and he fought hard. In the autumn of life his character was gentler and more mellow, and he was spared its winter. To his many friends and students he showed, time and again, the most thoughtful, unwearying kindness. A great factor in his life was the wise help and comfort of his able and interesting wife Elsie Monro, eldest daughter of William Ramsay, of Bowland, Scotland. Her death, two years ago, left him rather a desolate man, although he wore a brave face.

Of his work in England since his retirement Lord Rutherford writes of McLennan authoritatively: "Largely through his influence, the Union Minière of Brussels generously lent 5 gm. of radium to make a thorough investigation of the effects of mass radiation on cancerous growths. A committee was formed to control this great experiment, presided over by the president of the Royal Society supported by the presidents of the Royal College of Physicians and Royal College of Surgeons, and representatives of the Medical Research Council and the Department of Scientific and Industrial Research. This work, which is still in progress, is being carried out at the Radium Institute. McLennan threw himself whole-heartedly into this new line of work, and personally supervised every detail of the scheme. He spent much of his time at the Institute, and characteristically established the friendliest relations not only with the staff but also with the patients under examination. His services to this investigation in radium beam therapy are indeed great, and his sudden removal is an irreparable loss. Warm-hearted and impulsive, his vitality, his boyish enthusiasm and transparent simplicity of nature, endeared him to all those who came closely into contact with him. His sudden end in the full tide of his activities is a great loss to science and humanity."

McLennan was born on April 14, 1867, and died of heart failure on his way from Paris to Calais on October 9, at the age of sixty-eight years. He received many and well-deserved honours. In 1924, he was president of the Royal Society of Canada and two years later was awarded the Flavelle Medal by that Society. He was elected a fellow of the Royal Society in 1915, and in the current year he received his knighthood. A. S. EVE.

Prof. Henry Briggs, O.B.E.

PROF. HENRY BRIGGS, who died in London on August 26 at the age of fifty-two years, had become, after a distinguished career, an authority on many subjects related to the scientific side of coal-mining. As head of the Department of Mining at Heriot-Watt College and Hood professor of mining at the University of Edinburgh, his influence amongst all students of mining technology was widely felt. In particular, mining engineers looked to Prof. Briggs for advice and information, based on his own original researches, on mine ventilation, on surveying and on the nature of coal. Latterly, he had interested himself in the subject of the production of oil from coal and carbonaceous materials, and had been appointed chairman of the Oil from Coal Committee of the Scottish National Development Council. He was a member of many scientific and technical societies, a member of council of the Institution of Mining Engineers and a fellow of the Royal Society of Edinburgh.

Briggs received his early education at Bradford whence, with a National Scholarship, he went to the Royal School of Mines and obtained the associateship with honours. He received his practical training in mining at collieries in Yorkshire, Cumberland and Wales and, previous to his appointment (in 1919) to the chair of mining at Heriot-Watt College, was, successively, demonstrator at the Royal School of Mines (and research assistant to Sir Clement le Neve Foster) and lecturer in mining at the University of Birmingham. His earlier research work included studies of mine rescue apparatus, and he was the inventor of an oxygen-breathing apparatus; during the War he carried out a number of investigations for the Trench Warfare Committee.

All Briggs's work showed originality of outlook and clarity of thought, and all his writings, with which he took particular pains, were lucid and literary. He had a keen and somewhat mordant wit which rendered his participation in discussions of controversial subjects highly effective; albeit he was constructive in his criticism. The coal-mining industry will feel his loss. R. V. WHEELER.

News and Views

Billingham Hydrogenation Plant

THE formal opening on October 15 by Mr. Ramsay MacDonald of the coal hydrogenation petrol plant of Imperial Chemical Industries, Ltd., at Billingham-on-Tees, marks the start of a completely new British industry. Reference to the present position of commercial hydrogenation of coal has already been made in these columns (NATURE, April 6, 1935, p. 538). The Billingham plant is the first in the world to make petrol on a commercial scale from bituminous coal. It was originally intended to produce 100,000 tons a year of petrol from coal. It was later decided to increase the capacity to 150,000 tons, the extra 50,000 tons to be made either from coal or creosote oil and low-temperature tar. The first section was ready in January, 1935. Creosote oil was used as the starting material, and the first petrol was made in February. The first coal unit was started in June, and the output is expected to reach the designed figure before the end of this year. The normal rate of production is 410 tons or 123,000 gallons of petrol a day. 40,000 tons of petrol have already been made, of which 27,000 tons have been shipped to the oil companies for distribution. The coal consumption is estimated as 4 tons of coal to 1 ton of petrol produced.

THE raw coal is cleaned to less than 2½ per cent of ash and is ground up with oil previously made in the process to make a 50 per cent coal-in-oil 'paste'. This is injected against the working pressure of 250 atmospheres and mixed with hydrogen. The mixture is heated up to reaction temperature, and liquefaction of coal takes place at 450° C. A small heavy oil fraction containing the unconverted coal (5 per cent by weight) and ash is treated for oil recovery, and the coke residue is used as a fuel. The major part of the coal is transformed into lighter oils which are vapourised, and are recovered on cooling the gaseous products leaving the converters. The crude oil so obtained is distilled into heavy oil, middle oil and petrol. Heavy oil is further hydrogenated, in plant exactly similar to that used for the hydrogenation of coal, to give middle oil and petrol. Middle oil resulting from these two steps is further hydrogenated in vapour phase converters, in which the vapourised light oil and hydrogen are passed over a solid catalyst. The crude vapour phase product is distilled, the residual middle oil being separated from petrol and treated again. The whole of the coal is thus transformed into a small solid consumable residue, gas and petrol. Creosote oil and low temperature tars, although they play no essential part in the main process of making oil from coal, are conveniently treated along with the coal. The final petrol, after a simple purification, is pumped to storage tanks beside the River Tees, from which it is shipped by steamers.

Mr. Ramsay MacDonald's Tribute

IN his opening address, Mr. Ramsay MacDonald said that a little more than a generation ago, oil was displacing coal as a source of power, and chemists began to wonder whether it was not possible to 'resurrect' coal. The German chemists were the pioneers and among them stands conspicuously the name of Dr. Bergius. In 1921 he explained his ideas to the Department of Scientific and Industrial Research, and in 1923, under his influence, experiments were begun by the Fuel Research Station. "At that time, fortunately for the chemical industry, Sir Alfred Mond was living. . . . This country does not yet know what debt it owes to Sir Alfred Mond's vision. The result then was that the Government gave a subsidy to enable the necessary research to be prosecuted." In 1927 the experiments were taken over by the Imperial Chemical Industries; that secured that they would be conducted on the scale, and with the expenditure, necessary for their success. As a result of these experiments, the Government again came in. On July 17, 1933, Mr. MacDonald announced in the House of Commons that the Government would guarantee a preference to all British-produced motor spirit; and in March 1934 Parliament passed the Hydrocarbon Production Act. "Few announcements have had such far-reaching results. The immediate effect was that Sir Harry McGowan, that man of vision and energy, announced that Imperial Chemical Industries would at once proceed to erect a plant, and we are here within a year and a half to open it."

Sir Harry McGowan's Reply

SIR HARRY MCGOWAN, on behalf of Imperial Chemical Industries, Ltd., thanked Mr. Ramsay MacDonald for his address. He said that the opening of the Billingham plant has brought to a practical commencement an enterprise which has engaged the attention of his firm for many years. "We began at Billingham in 1927 on a very small scale indeed. For two and a half years research continued on a moderate scale, and by then it was clear that to achieve success a bold expansion policy was essential. Notwithstanding the discouraging business conditions of 1930 and 1931, we launched in those years an extended programme of work at a heavy annual cost. . . . In the end we spent more than a million pounds on this research." During this period active encouragement was given by H.M. Government and interest was displayed in the work by the Fuel Research Board. Similar activities were proceeding abroad though from slightly different angles. The German I.G. was at work on brown coal, the Standard Oil Company of New Jersey was occupied with petroleum oil, and the Shell Group were not inactive. "In 1931 we effected with these three companies a pooling of all interests in the hydrogenation process,

including a provision for a complete exchange of information, which promoted a more rapid advance by bringing us into immediate touch with every development of major importance." The construction of this plant marks the culmination of eight years' work. "The chemists, engineers, metallurgists, draughtsmen, and workers may all be proud when they look at this plant. To name them is impossible, but without being invidious I desire to single out Mr. Kenneth Gordon, who has been in charge of the research work and construction of the plant, and also my colleague Colonel Pollitt, who was the inspiration of our earliest efforts."

Tercentenary of Wilhelm Schickard (1592–1635)

ON October 23, 1635, in the middle of the Thirty Years' War, Wilhelm Schickard, a famous German orientalist and astronomer, died of the plague at Tübingen. Schickard was born on April 22, 1592, at Herrenberg, Württemberg. He was educated for the church, and at an early age became known for his knowledge of Hebrew. At the age of twenty-seven years he was appointed to the chair of Hebrew at Tübingen, and in 1631 was made professor of astronomy. He was also an inspector of schools at Stuttgart. In some of his least-known books are to be found early observations on the aurora, an account of the comet of 1623 which caused considerable commotion on its appearance, and his views on the refraction of light and the theory of the rainbow. He was known to both Kepler and Gassendi, and the latter, after he had observed at Paris the transit of Mercury of 1631 predicted by Kepler, wrote to Schickard: "The crafty god had sought to deceive astronomers by passing over the sun a little earlier than was expected, and had drawn a veil of dark clouds over the earth in order to make his escape more effectual. But Apollo, acquainted with his knavish tricks from his infancy, would not allow him to pass altogether unnoticed. To be brief, I have been more fortunate than those hunters after Mercury who have sought the cunning god in the sun. I found him out, and saw him, where no one else had hitherto seen him." Gassendi, in another letter of the same year, gave an account to Schickard of his fruitless efforts to see the transit of Venus.

Work of the Meteorological Office

THE annual report of the Director of the Meteorological Office for the year ended March 31, 1935 (London: H.M. Stationery Office. 9*d*. net), records a further big increase in the amount of information supplied to the public and to aviators, in accordance with a tendency that has been much in evidence for several years. The Aviation Services, for example, report a total increase of 18,747 in inquiries and of 2,404 in weather reports passed to aircraft in flight; in the British Climatology Division 2,348 general or scientific inquiries were dealt with, this figure including 178 legal inquiries, representing nearly a six-fold increase as compared with 1924–25 and nearly a doubling of the volume of inquiries in the past five years. While the main work of the Meteorological Office during the year under review has been on the same lines as in previous years, certain changes of organisation have been completed. Since the reorganisation after the War, there have been separate divisions for forecasts and aviation, but as experience has shown that this arrangement is not the best from the point of view of efficiency, the two divisions have been combined since October 1, 1934, control of the single large division by a single head, with two senior officers as deputies, being aimed at eventually. The Naval Division has for years been working in co-operation with the Admiralty towards the creation of a weather forecasting service within the Fleet which shall be self-contained but not independent of the State Meteorological Service; that objective has been attained with the expectation of its being in full operation by the end of 1936. Other important changes include a restriction of the responsibility of the Meteorological Office in the matter of gale warnings to the issue of the warning telegrams, the Board of Trade being responsible, as from September 1, 1934, for the exhibition of the warnings and the supply and maintenance of warning cones for that purpose; and the taking over by the Ministry of Agriculture and Fisheries and the Fishery Board of Scotland of the supervision of the stations of the Fishery Barometer and Barograph Service as from January 1, 1935.

THE fusion of the two branches of the Meteorological Office formerly known as the Forecast and Aviation Divisions, referred to above, does not involve any radical change in the system of dealing with weather forecasts and reports in connexion with aviation. Nevertheless, there have been some developments of the existing system. Consequent upon the increased practice by pilots of following direct compass courses on flights from Great Britain to the Continent, it was found necessary to alter the position of auxiliary weather reporting stations formerly established to serve the old Continental air routes. This has led to the closing down of the auxiliary weather reporting stations at Farningham, Deal, North Foreland and Sandgate, and the opening of new stations at Leatherhead, Crowborough and Bexhill, and to an increase in the personnel of the meteorological station at Manston Aerodrome to make practicable the issue of reports throughout the twenty-four hours. Another development was the installation at Croydon Airport of a 'ceiling projector'. This is a searchlight arranged to send a powerful beam of light vertically upwards, which enables the height of low cloud over the airport to be measured at night. The measurements are made at the meteorological station itself, and cloud heights are supplied in response to requests from pilots flying at night. Stations newly established within the period under review included one at Abingdon to meet the requirements of Central Area Headquarters of the Royal Air Force, and another similar station at the new Royal Air Force station at Mildenhall (Suffolk). Both these stations have personnel capable of obtaining information about the state of the upper atmosphere and making forecasts. These additions brought the number of local forecasting centres in Great Britain up to twenty-five.

River Bank Protection

FOR the Inland Navigation Section of the Sixteenth International Congress of Navigation, Brussels, 1935, Dr. Brysson Cunningham prepared a report on "The Estuarial Embankments of the River Thames". Of the origins of these walls little is definitely known and, in his "History of the Port of London", Sir Joseph Broodbank inclines to the view that their construction was a gradual and piecemeal process undertaken locally with the purpose of reclaiming for agriculture the valuable lands along the banks of the river, and probably initiated by immigrants from Flanders familiar with work of this kind. As he also says, "The builders in carrying out their object would not trouble themselves as to the effect their work had on the stream nor did they realise that they were, in fact, performing a mighty service in providing for London one of its greatest assets as a Port". Records of repairs and alterations have been traced back to the time of Edward II, and about that time Commissions of Sewers—using the word in its original sense—began to be appointed to exercise jurisdiction in several localities. Until 1930, when the Land Drainage Act established Catchment and Drainage Boards to take over their duties, these Commissions acted under the authority of an Act of 1531 to protect the lands from being flooded either by inundation or accumulation of superfluous waters. As consultant engineer to two of these bodies entrusted with portions of the Thames Embankments, Dr. Brysson Cunningham was able to advise the Congress as to the nature of the problems presented, and gave an account of the construction, maintenance, repair and renewal of these walls. Altogether, the earthworks on both sides of the river below London Bridge have a total length of approximately 120 miles and give protection to 64 square miles of low-lying marshland. Being 4–5 feet above Ordnance Datum while H.W.O.S.T. level is 10–13 feet, these extensive lands would, without protection, become permanently flooded. In the report, the several inimical agencies are described and, by maps, sections and diagrams, the methods and materials used to ensure adequate defence are fully exhibited.

Research on Combustion

NO one is better qualified than Prof. W. A. Bone to give an account of "Fifty Years of Combustion Research"—the title of his William Young Memorial Lecture, delivered to the North British Association of Gas Managers on September 12. The account gives a readable and comprehensive story mainly of the work due to the late Prof. H. B. Dixon and his school, and not least of Prof. Bone himself and his pupils. The lecture included some of the more recent observations on the combustion of gases at very high initial pressures, with activation of nitrogen, the description of some of the curious phenomena such as the 'spin' of the flame head in the detonation wave—observations calling for remarkable achievements in high-speed photography. The existence recently observed of double ranges of ignition temperatures of gases with an intervening 'inert' zone of temperature emphasises the complexity of the process of ignition. The 'chain theory' which has been so extensively used to account for combustion phenomena is held to be not 'mere moonshine' but to merit critical reception when capable of being harmonised with experiment. Prof. Bone closes with the insistence on the necessity of perpetual experimentation, for as Priestley said, "Speculations without experiments have always been the bane of natural philosophy".

Chemical and Physical Society, University College

THE Chemical and Physical Society, now the senior Society of University College, London, opened its sixtieth session on October 15. Before a large and distinguished gathering Dr. Henry Forster Morley, a founder-member and third president of the Society, unveiled oak panels bearing the names of the former presidents, many of whom were actually present. It was unfortunate that Sir Oliver Lodge, who was president of the Society in its first two years, was unavoidably absent on this occasion. The unveiling itself, in accordance with the principles of the Society, was performed electrically by means of an engraved silver switch, which was afterwards formally presented to Dr. Forster Morley. Mr. C. F. Goodeve, this year's president, who was in the chair, then introduced the other speakers, among whom were the Provost, who accepted the panels on behalf of the College, and Prof. A. W. Porter and Prof. M. W. Travers, who made a few interesting remarks about the earlier presidents. The secretary, Mr. R. H. Leach, thanked the many friends of the Society for their assistance, financial and otherwise.

Preservation of Cliff Scenery

IN a paper to Section E (Geography) of the British Association at Norwich on September 5, Dr. Vaughan Cornish directed attention to the menace afforded by private enclosure to the best of the cliff scenery of England and Wales. Of the 1,800 miles of coast line, about five hundred are cliff land, of which more than three hundred miles are in Devon, Somerset and Cornwall. For the most part, the cliff edge is still accessible to the pedestrian, but too often the landward side has been enclosed and thus the full enjoyment of the view is impaired. Dr. Cornish calculates that 40,000 houses would line the whole of the five hundred miles, and believes that with the present rate and spread of building it will not be many years before much of the cliffs will be enclosed. He advocates the public acquisition under the Town and Country Planning Act, supplemented if possible by other funds, of a strip of land 110 yards wide along all the cliffs. This would amount in all to 20,000 acres and the purchase figure would be approximately £2,000,000. Thus, for a relatively small cost the finest scenic treasures of the country would be preserved.

Fossil Human Occipital Bone from Thames Gravels

DURING the recent meeting of the British Association at Norwich, Mr. Alvan T. Marston exhibited to Section H (Anthropology) a complete human

occipital bone which he had found in the middle gravels of the 100-ft. terrace of the Thames at Swanscombe, Kent. The bone was associated with Acheulean flint implements, and is mineralised in the same way as the bones of the Pleistocene mammals occurring with it. The fossil was submitted to the Geological Survey, and Mr. Henry Dewey confirmed the determination of its geological age. Mr. Marston now writes that he has made an endocranial cast of the specimen and has consulted Sir Grafton Elliot-Smith, who expresses the opinion that "the exceptional size and form of the visual territories upon the two hemispheres of the endocranial cast, even if they suggest left-handedness, are definitely Simian and point to a much more primitive stage than *Eoanthropus*". The bone differs considerably from the occipital of *Eoanthropus*, and further discoveries to reveal the characters of the skull to which it belongs will be eagerly awaited.

Ancient Ruins in East Africa

An archæological reconnaissance with the view of further investigation has been made recently by Dr. L. S. B. Leakey on two sites in East Africa. Of these, one, the ruins of Gedi, an ancient city of considerable extent, sixty-five miles north of Mombasa, is already scheduled under the Ancient Monuments Preservation Ordinance ; the other is the large assemblage of stone-built dwelling-places and tombs at Engaruka in the Great Rift Valley in Tanganyika, to which attention was directed as a new discovery in June last of Mr. T. E. Wetherell. The ruins at Gedi, though situated at no more than fifty yards from the Mombasa-Malindi road at their nearest point, are so obscured by a tangle of tropical vegetation as almost to escape notice. Trees of considerable size growing on or in the ruined structures afford some gauge of the antiquity of the ruins. According to Dr. Leakey's report (*The Times*, October 11) future investigation will reap a rich harvest. Town walls, buildings and tombs alike afford evidence of at least two, and possibly three, distinct periods of construction. The materials used consist of dressed blocks of coral, built up with a hard mortar and plastered to a smooth surface. In places, where the dressing is unplastered, as on the arches over doors and windows, it is extremely fine. It is Dr. Leakey's opinion that the ruins may be those of an Arab or Persian settlement of considerable antiquity, the first settlement possibly dating so far back as the beginning of the Christian era.

Dr. Leakey's investigations at Engaruka confirm previous reports of the extent of the site, though the limits at present are unknown. He estimates that the buildings in the North and South Ruins on the slope number five to seven thousand ; and there are further structures in addition to the tomb mounds below in what he terms the Valley Ruins. The ruins are not entirely a new discovery, as recently reported. They had been visited by Dr. Hans Reck on his way to Oldoway in 1913, when he excavated one or two mounds ; and more recently a little digging has been done by British administrative officials. Dr. Leakey carried out one or two exploratory excavations of mounds and buildings, but failed to obtain any material, either skeletal or cultural, which throws light on the dating of the site. It is evidently not of high antiquity. The buildings are entirely of dry stone-walling, without mortar, and show no real skill in stone building. Inquiry among the Masai elicited the tradition that the ruins had been abandoned about one hundred years ago when the Masai drove out the ancestors of the present-day Wambulu. A further tradition of a Portuguese leader or king at Engaruka may, it is thought, afford an explanation of how a people who do not now build in stone, nor live in towns or even villages, came to erect these stone structures in such numbers.

Linguistic Research in Kashmir

It is reported that Colonel D. L. R. Lorimer, whose studies in Indo-Iranian linguistics are well known, accompanied by Mrs. Lorimer, has recently returned to Srinagar from an expedition of linguistic research among the mountain tribes of Hunza and the area to the north, upon which he has been engaged during the last fifteen months. The chief object of the expedition was to extend and complete Colonel Lorimer's studies of Burushaski, the language of the Burusho of Hunza ; but he has also devoted attention to Wakki, a language of the Iranian group spoken in Wakkan and also by Wakkan settlers in northern Hunza. Colonel Lorimer, it is stated in a dispatch from Srinagar in *The Times* of October 9, has succeeded in obtaining a record of a language, Boma, hitherto unknown, spoken by a tribe of musicians and metal workers who have been settled in Hunza for many generations. According to their own tradition, they are a people of Badakhshari origin, who at some period were transferred to the rule of the Mir of Hunza for services he had rendered the ruler of Badakhshan. They have remained an exclusive group and still do not intermarry with the Burusho, although they, like the other peoples of Hunza, are Moslems. Hence while they speak Burushaski fluently, they have retained their cultural and linguistic individuality intact. Their language, which is said not to resemble the Badakhshani of their traditional place of origin, appears to be more closely related to the Sanskritic than to the Iranian members of the Indo-Iranian linguistic group. If this be confirmed by further study, it would agree with the character of other languages of the so-called Dards of Hunza. Colonel Lorimer is now about to return to England for the purpose of studying the large amount of ethnographical and linguistic material he has collected among the less well-known mountain peoples of the area.

Marine Research at Millport

The report for 1933–34 of the Scottish Marine Biological Association, Millport, shows that much work has been done during the year. The director, Mr. R. Elmhirst, has studied specially the conditions under which shore algæ live, and subdivides the

littoral area into three natural algal belts correlated with the run of the tide. This tidal flow theory also fits closely to the observed distribution of various animal species inhabiting the sandy and muddy areas of the tidal zone. Mr. A. C. Stephen, following up his previous reports on molluscan ecology, has found that in 1933 the density of population of *Tellina tenuis* was far in excess of any previously met with, on an average 8214 per square metre. This was largely composed of a very abundant spat. The closely related *T. fabula* was also very successful in its spatting, but the conditions were evidently not so favourable for the common cockle, *Cardium edule*, very little spat of this species occurring. Dr. Orr, Dr. Marshall and Dr. Nicholls, in continuing their co-operative work on the plankton with special reference to *Calanus*, have shown that the success or failure of a brood depends on the presence or absence of diatoms during the early stages of development. A study of the chemical composition of *Calanus* showed that the fat content followed the changes in weight, and that the protein content also followed in general the changes in weight. Spent females were rarely found, which indicates that they die soon after spawning. An unusual occurrence was noted in the behaviour of Stage V *Calanus* on one occasion, when they swarmed actually on the surface of the water for two or three days, remaining in the upper few metres nearly all the time and only showing a tendency to seek deeper water during the darkest part of the night, which is a complete reversal of the normal migration. This subject is undergoing further investigation.

Public Health in England and Wales, 1934–35

THE sixteenth annual report of the Ministry of Health, 1934–35, has recently been issued, and deals under six sections with the whole subject of the public health and its administration in England and Wales (Cmd. 4978. H.M. Stationery Office, 1935. 5*s*. 6*d*. net.). Sir Kingsley Wood, the Minister of Health, in his introduction, contrasts mortality rates for the years 1910 and 1933. Thus, the death rates per 1,000 living for these two years were, respectively, 13·2 and 9·3; the infant mortality rates were 105 and 64, the death rates per million from pulmonary tuberculosis were 988 and 639, and for typhoid fever, 53 and 5. Maternal mortality, however, in spite of the development of maternity services in recent years, has not yet begun to fall. Statistics of vaccination show a slight but steady decline, from 42·6 per cent of total births in 1928 to 37·0 in 1933. Samples of food and drugs analysed during 1934 numbered 140,583, a small increase over the previous year, of which 7,451 or 5·3 per cent were reported against. It is mentioned that in some districts there are signs of revival and expansion of canal traffic, and there is evidence that motor traction of canal boats is continuing to develop, for many motor-propelled boats are on order, such boats being notable for improvements in design as regards ventilation and sanitation compared with the old type of boat.

Destructive Earthquakes in 1935

IN a recent number of the *Matériaux pour l'Étude des Calamités* (No. 35, 82–86; 1935), M. Charles Bois continues his record of destructive earthquakes. During the first six months of this year, there were 16 such earthquakes, four of them resulting in considerable loss of life, namely, the Persian earthquake of April 11 (480 deaths), the Formosa earthquake of April 20 (3,065), the Caucasian earthquake of May 1 (600) and the Quetta earthquake of May 30 (40,000). The latter number is probably too high, the latest estimate being about 30,000. On the other hand, the number of deaths (2,000) given by M. Bois for the Bihar earthquake of January 15, 1934 (NATURE, **136**, 472, September 21, 1935), is too low, the number given in the official report on the earthquake being more than 10,000.

Third World Power Conference

THE third World Power Conference will be held in Washington, U.S.A. on September 7–12, 1936. This will be the third plenary meeting of the World Power Conference, the first plenary meeting having taken place at Wembley in 1924, and the second at Berlin in 1930. There have, in addition, been a number of sectional meetings. The Chemical Engineering Congress of the World Power Conference, to be held in London next June, ranks as one of these series of sectional meetings. The general subject to be discussed at the Third World Power Conference is "National Power Economy". Among the aspects to be treated are the following: physical and statistical bases; technical, economic and social trends; organisation of fuel industries and of gas and electric utilities; public regulations; national and regional planning; conservation of fuel and water resources; rationalisation of distribution; national power and fuel policies. The second Congress of the International Commission on Large Dams of the World Power Conference will be held in Washington at the same time. Further particulars regarding the plenary meeting of the World Power Conference and the second International Congress on Large Dams will be issued in due course. British participation will be organised by the British National Committee of the World Power Conference, 36 Kingsway, London, W.C.2.

Work of the Medical Research Council

IN a pamphlet by Miss Norah Dacre Fox, issued by the London and Provincial Anti-Vivisection Society, an attempt is made to criticise the work carried out under the Medical Research Council. Reference is made to the dominating influence of the late Sir Walter Fletcher, to vested interests, to a suppressed report, etc. It is stated: "The public is the Master, the Medical Research Council its servant. Is it not entitled to assert itself and to require from those it remunerates so lavishly, an account of this stewardship?" Needless to say, an account of this stewardship is available to all who desire it in the annual report and in the numerous research reports issued by the Council.

Announcements

PROF. JOHN A. RYLE, regius professor of physic in the University of Cambridge, and Prof. Matthew J. Stewart, professor of pathology in the University of Leeds, have been appointed members of the Medical Research Council in succession to the Right Hon. Lord Dawson of Penn, and Prof. A. E. Boycott.

AT the annual dinner of the Institute of Fuel, held on October 9, the Melchett Medal was presented to Mr. Harry R. Ricardo for his work on internal combustion engine operation and its relation to fuel.

AT the annual general meeting of the Association of British Chemical Manufacturers, Dr. E. F. Armstrong was elected president in succession to Sir Christopher Clayton.

THE new auxiliary laboratory of the British Electrical and Allied Industries Research Association will be opened by H.R.H. The Duke of Kent at Perivale, Middlesex, on October 22, at 3 p.m.

The eleventh annual Norman Lockyer Lecture of the British Science Guild will be given by Sir Josiah Stamp, who has chosen as his subject "The Calculus of Plenty". The lecture is to be delivered in the Goldsmiths' Hall (by permission of the Goldsmiths' Company) on Wednesday, November 13, at 4.30 p.m.

DR. E. L. HIRST will deliver a lecture on "The Chemical Nature of Vitamins" before the University of Durham Philosophical Society on November 1 at 6.30. The meeting will be open to the public.

SIR WALTER LANGDON-BROWN will deliver the fifth Victor Horsley Memorial Lecture in University College Hospital Medical School, Gower Street, W.C.1, on November 19 at 5 p.m. The subject of the lecture will be "The Integration of the Endocrine System". Admission to the lecture will be free.

IT has been decided to hold the Huxley Lecture at the Imperial College of Science and Technology in alternate years only, and in the other years to hold lectures commemorating other distinguished men who have served on the staff of the College. The first of the new series of lectures will be held on May 4, 1936, at 5.30 p.m., and will be given by Prof. G. T. Morgan. The lecture will be called "The Hofmann Memorial Lecture".

THE second Hinchley Memorial Lecture of the Institution of Chemical Engineers will be delivered by Sir Harold Hartley on October 25, at 6.30, in the Lecture Theatre of the Institution of Civil Engineers, Great George Street, S.W.1. The subject of the lecture will be "Our National Coal Resources". The lecture is open to non-members, for whom tickets can be obtained from the Assistant Secretary, Abbey House, Westminster, S.W.1.

THE first Italian congress on alimentation, organised by the National Medical Syndicate, the committee for the study of the problems of alimentation and the National Research Council, will be held in Rome on October 23–26. At the inaugural meeting, Prof. Filippo Bottazzi will speak on the organisation of scientific research in the service of the national food supply, and Prof. Eugenio Morelli will discuss the work of the doctor in alimentary propaganda.

PROF. BERNARDO A. HOUSSAY, of the Institute of Physiology, Buenos Aires, has been appointed a member of the Permanent International Committee of the Physiological Congresses. The names of the other members of the Committee were given in NATURE of October 12 in the article on the recent Congress held in the U.S.S.R. (see p. 573). Prof. Houssay's election is a welcome acknowledgment of the value of the work of the growing schools of physiology in South America.

MESSRS. ALLEN AND UNWIN, LTD., announce the early publication of "Coral Gardens and Their Magic" by Prof. Bronislaw Malinowski; also "How Animals Develop" by C. H. Waddington, which affords a short account of the science of embryology.

MESSRS. W. Watson and Sons, Ltd., 313 High Holborn, W.C.1, have recently circulated a new issue of part 6 of their microscope catalogue, dealing with microscopes and accessories for polarising purposes, which will be sent gratis to those interested. Two new models have been introduced, the 'Service', 'School of Mines', and 'Advanced' petrological models have been re-designed, and the last two can now be supplied with horse-shoe, instead of tripod, foot if preferred. A demonstration set has also been designed for school purposes in order to demonstrate the phenomena of polarised light, and other new patterns of apparatus are figured and described.

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

A lecturer in mining in the University of Leeds—The Registrar (Oct. 22).

An examiner in the Aeronautical Inspection Directorate—The Secretary (S.2.d.), Air Ministry, Kingsway, W.C.2 (Oct. 26).

An assistant engineer in the Chief Engineer's Department of the London County Council—The Clerk to the Council, County Hall, S.E.1 (Oct. 28).

A lecturer in electrical engineering and a lecturer in mathematics and electrical engineering in the South-East London Technical Institute—The Education Officer, County Hall, S.E.1 (Oct. 28).

A junior scientific officer and an assistant (III) at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Oct. 30).

A lecturer in mathematics in the Edinburgh Training Centre—Prof. Godfrey H. Thomson, Director of Studies, Moray House, Edinburgh, 8 (Oct. 30).

A lecturer in mathematics in the Saltley Church of England Training College for Schoolmasters, Birmingham—The Principal (Nov. 1).

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 647.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

'Autogenous' Strains of '*Culex pipiens*' (Diptera, Culicidæ)

IN a letter published in NATURE of January 5, 1935 (**135**, 34), we directed attention to the discovery, at Hayling Island (Hampshire), of a 'strain' of the mosquito *Culex pipiens* exhibiting certain abnormal characteristics (notably the ability of the females to lay fertile eggs upon a blood-free diet) which Roubaud has designated by the adjective 'autogenous'. Such autogenous strains of *C. pipiens* had previously been recorded only from France[1], Germany[2], Greece[3], Hungary[3] and Malta[3]. Roubaud, who considered his autogenous strain and the ordinary ('anautogenous') strain to be morphologically identical[4], indicated their biological differences by naming them respectively *Culex pipiens autogenicus* and *Culex pipiens pipiens*[5].

We find that, in three different stages of development, the Hayling autogenous strain of *C. pipiens* can be morphologically distinguished from the anautogenous strain. The adults are recognisable by the lighter colour of the thorax, by the greater average number of hairs on the lobes of the 9th tergite, and by the shortness of the male palps; the larvæ, by their much lower siphonal index and by the greater average number of branches in the siphonal tufts; and the eggs, by their greater width relatively to their length. The female adults (as already noted in the case of other autogenous strains) also differ from the anautogenous ones by reason of the fierceness with which they attack human beings.

Our investigations prior to March 8 last are fully described in an article about to appear in *Parasitology* (**27**, No. 4), the editor of which journal, Prof. D. Keilin, has very kindly given us permission to refer in this letter to the two subsequent developments summarised below.

(1) In our *Parasitology* article we allude to the (hitherto unexplained) fact that females of *C. pipiens*, although regarded in England as being chiefly 'bird-biters', occasionally exhibit 'man-biting' proclivities in residential districts. We have made the suggestion (supported by evidence provided by the examination of man-biting adults captured in a London hotel in the year 1930) that, in all such cases, an autogenous strain of *C. pipiens* has been concerned. Opportunities of confirming the validity of this assumption have recently been furnished by infestations of man-biting *C. pipiens* in (*a*) a block of flats in Westminster and (*b*) a row of cottages in Hull. Both from a blood-filled female (caught in a bedroom) in the first case, and from larvæ collected near the infested buildings (by kindness of the Medical Officer of Health for Hull, Dr. Gebbie) in the second case, we have established, and are maintaining, an autogenous strain.

(2) We are now rearing autogenous strains derived from Hayling, London, Hull, France and Greece—the last two by kindness of Prof. Roubaud and Dr. P. Tate respectively. We are indebted to Dr. Tate also for larval and adult specimens of the Hungarian and Maltese strains. We find that all these strains resemble one another, but differ from the anautogenous *C. pipiens* in the following respects. In the larvæ, the siphonal index lies between 3·8 and 4·3; in adults of both sexes, the thorax is light-coloured; in male adults, the first division of the mesosome is unusually broad and the combined length of the first four segments of the palp does not exceed the overall length of the proboscis; in female adults, the venter is, both medianly and laterally, devoid of dark scales.

In regard, however, to the chætotaxy of the larval siphon and of the 9th tergites, the seven strains differ noticeably from one another. In the Hungarian strain, for example, the 'tuft-branch' count is low and the 'tergite-hairs' count high; in the Hayling strain, both counts are high; and in the London strain, they are both low. A remarkable characteristic of the Greek strain is the large proportion of larvæ (about 40 per cent) which have three siphonal tufts instead of four.

It appears, therefore, that Roubaud's original (French) *C. pipiens autogenicus* is but one of a number of autogenous strains, all of which differ very markedly from the anautogenous *C. pipiens*, and also—to a lesser but quite obvious extent—from one another. In view of this fact we submit the suggestion that some specific name other than *pipiens* should be adopted to designate both the present and later-discovered members of this autogenous, short-siphoned, short-palped group: varietal names (preferably of geographic import) being appended whenever the recognition of definite morphological or biological differences renders such action desirable. In favour of reviving the specific name *domesticus*, Germar, for this purpose there is a great deal to be said.

J. F. MARSHALL.
J. STALEY.

British Mosquito Control Institute,
Hayling Island, Hants.
Oct. 8.

[1] Roubaud, E., *C.R. Acad. Sci.*, **188**, 735; 1929.
[2] MacGregor, M. E., *Trans. Roy. Soc. Trop. Med. and Hyg.*, **26**, 307; 1932.
[3] Tate, P., and Vincent, M., *Parasitology*, **28**, 512; 1934.
[4] Roubaud, E., and Toumanoff, C., *Bull. Soc. Path. exot.*, **23**, 196; 1930.
[5] Roubaud, E., *Ann. Sci. nat.* (10), **16**, 5; 1933.

Gorilla Skulls in the Bristol Museum

In the course of rearrangement of the study collections in the Department of Zoology, it has recently been discovered that the Bristol Museum and Art Gallery possesses the three gorilla skulls (Reg. Nos. Ab 1993, 1994, 1995) from which Prof. (afterwards Sir Richard) Owen first described this animal to the Zoological Society of London in a paper read on February 22, 1848. This was published in *Trans. Zool. Soc.*, 3, pp. 381–422 (1849) and Plates LVIII–LXIII as "Osteological Contributions to the Natural History of the Chimpanzees (Troglodytes, Geoffroy) including the description of the skull of a large species (Troglodytes Gorilla, Savage) discovered by Thomas S. Savage M.D. in the Gaboon Country, West Africa". One of the skulls (Ab 1993) is figured in Plates LXI–LXIII and, as related on p. 391, they were procured in December 1847.

In a later paper by the same author in *Trans. Zool. Soc.*, 4, pp. 75–77 (1862), a detailed description is given of another skull (Ab 1996), and it is figured in Plates XXVI–XXVIII. The bisection of the skull was carried out under Prof. Owen's direction as mentioned on p. 77.

Casts of these four skulls were presented to the Museum of the Royal College of Surgeons in 1848, and appear as Nos. 5180–5183 in "Descriptive Catalogue of the Osteological Series. Vol. II. Mammalia Placentalia" (1853) where, on pp. 803–805, there are descriptions, including a further detailed one of Ab 1996.

Some more notes are given on p. 9 of a later "Catalogue of Specimens illustrating Osteology and Dentition of Vertebrated Animals, Part II. Mammalia other than Man" (1884) by W. H. Flower and J. G. Garson.

In addition to the above, there are in the collections another skull of a male presented at the same time (1848) as Ab 1996, and a mounted adult male and its skeleton received in 1865.

Details of these specimens are as follows:

(1) Skull of adult male, without mandible, procured by Capt. George Wagstaffe at the Gaboon River, West Africa, in December 1847. Brought to England by Capt. Wagstaffe, ship *Jno. Cabot*. Donor: Mr. S. Stutchbury, August 3, 1848. Reg. No.: Ab 1993.

(2) Skull of mature male, without mandible, same history and donor as No. 1. Reg. No.: Ab 1994.

(3) Skull of adult female, without mandible, same history and donor as Nos. 1 and 2. The top of the cranium has been divided from the rest of the skull. Reg. No.: Ab 1995.

(4) Skull of adult male without mandible, from River Danger (=Muni River), West Africa. Donor: Capt. Harris, ship *Englishman*, August 3, 1848. (This skull was bisected vertically and longitudinally later.) Reg. No.: Ab 1996.

(5) Skull of male, without mandible, from River Danger, West Africa. Donor: Mr. Townsend, ship *Englishman*, August 3, 1848. Reg. No.: Ab 1997.

(6) Mounted specimen of adult male from Gaboon River, West Africa. Donor: Mr. A. Gordon, of Gaboon, December 30, 1865. Reg. No.: A 4890.

(7) Complete skeleton of No. 6. The height of the animal was 5 ft. 5 in. Reg. No.: A 4837.

H. Tetley.

Bristol Museum and
Art Gallery.
Oct. 3.

Ring Deposits on Glass by Positive Ray Bombardment

Positive rays of hydrogen were passed through a hole of 2 mm. diameter and 6 mm. long in the centre of a cathode of brass faced with an aluminium plate. A glass window kept perpendicular to the beam, eleven centimetres behind the front face of the cathode, showed formations of deposits with well-defined rings after the tube was worked at different cathode falls corresponding to a maximum of 25,000 volts D.C., current 1·7 m. amp. The total time of exposure was about twenty-five hours. On examination by transmitted light of the place where the rays fell directly, it was found to be transparent. The rings were brown. The first ring is sharp and circular, with a thickness of 0·5 mm. and a diameter of 8 mm. The second ring is also quite circular, of the same thickness as the first, but not quite concentric with it. The diameter of this ring is about 16 mm. only; two-fifths of the third ring is visible, the diameter is 24–30 mm., but it is nearly concentric with the second ring.

The deposits have been observed by previous workers, but not the rings. Von H. Raether[1] examined similar deposits by electron diffraction, and concluded that they must be due to carbon formed from the decomposition of the hydrocarbons present in the discharge tube and produced from grease or at wax joints. The rings cannot be due to interference. The phenomenon presents many interesting features as a closer extended study with excellent photographic results has revealed, and will be reported in detail elsewhere.

B. Dasannacharya.
V. T. Chiplonkar.
L. G. Sapre.

Physical Laboratory,
Hindu University,
Benares.
Aug. 25.

[1] *Phys. Z.*, **34**, 492; 1933.

Spectra of SeO and SeO_2

In continuation of earlier work[1] on SO_2, the emission bands of SeO and the absorption bands of SeO_2 have been analysed. The former consist of a long $v'=0$ progression and a short $v'=1$ progression. The origin of the system cannot be definitely located but the $v'=0$ progression can be expressed by the following formula

$$\nu = 30433 - (882\ v'' - 6\ v''^2).$$

Considerations of intensity distribution lead us to 33167 cm.$^{-1}$ as ν_0 and $\omega''=910$ cm.$^{-1}$, and the energy of dissociation of unexcited SeO will therefore be 4·17 volts. The vibrational frequency of the excited state ω' is 513 cm.$^{-1}$

The analysis of the spectrum of SeO_2 indicates two modes of vibration ω_2 and ω_3 both in the ground and in the excited state, the deforming vibration ω_1 being absent. The frequencies of the symmetric valence vibration are $\omega_2''=901$ and $\omega_2'=663$ cm.$^{-1}$; those of the antisymmetric valence vibration are $\omega_3''=1189$ and $\omega_3'=790$ cm.$^{-1}$. The origin of the system lies at 32560 cm.$^{-1}$.

The theoretical selection rule for $\Delta v_{\text{antisym.}}$ of Herzberg and Teller[2] is found to be completely valid.

The close correspondence of the two energies of excitation, ω'' and ω'', ω' and ω_2'' of SeO and SeO_2 respectively, indicate strong localisation of the bonds.

This is corroborated by the atomic heat of formation of selenium dioxide, which has been calculated as $Se+O+O=SO_2+8{\cdot}9$ volts, which is almost double the energy of dissociation of SeO.

R. K. ASUNDI.
M. JAN-KHAN.
R. SAMUEL.

Dept. of Physics,
Muslim University,
Aligarh.
Sept. 1.

[1] R. K. Asundi and R. Samuel, *Proc. Ind. Ac. Soc.* (Bangalore), **2**, 30; 1935.
[2] G. Herzberg and E. Teller, *Z. Phys. Chem.*, B, **21**, 410; 1933.

The *L*-Emission Spectrum of Argon

OF the X-spectra of rare gases, the *K*-series of xenon and that of krypton have been measured[1], and from their absorption spectra the *K*-edge of argon[2], krypton[3] and the *L*-edge of xenon[3] are known. For the *L*-absorption edge of Xe, as well as for the *K*-edge of argon[4], a fine structure also has been found.

In the region of the long wave-lengths, no results obtained by direct measurements have been obtained hitherto. The values for absorption edges have been obtained by the method of magnetic spectra.

By studying with our ionic tube the reversed absorption edges of silver, bromine and potassium in the region of long wave-lengths[5] (which we will publish later on), we have found that if either N_2 or air has been let into the tube, the *K*-series of N_2 has occurred. Sometimes, there also appeared the absorption edge of nitrogen[6]. The absorption edge of N_2 appeared especially when the same pressure had been maintained in the spectrograph as in the ionic tube. Such a regulation and maintenance of the pressure in the spectrograph—which is possible by the application of the ionic tube—is important in the region of the long wave-lengths, where it is impossible to cover the slit. (The gas, which is let into the tube by means of a fine regulating glass valve[7], streams through the slit into the spectrograph, from which it is exhausted.) We have tried to obtain spectra of the rare gases mentioned with the arrangement described above, where the said ionic tube offers a very efficient source of the long X-rays[8]. It is now possible to operate with this tube with a tension of only 600 v. at 250–300 ma. The pressure in the tube under the given conditions is about 0·1 mm. Hg.

When argon is let in the above-mentioned way into the tube, the *L*-series of argon is obtained. As electrodes we have used aluminium with the deposit of lithium borate on the anticathode. For control, if H_2 has been let in instead of argon, only *K*-lines of boron (in 8 orders), *K*-lines of lithium and the *K*-absorption edge of carbon in the first and the second orders have been obtained. But when argon is let in, besides the expected argon lines, we have obtained also new lines, which are observed when H_2 has been the discharge gas. These new lines have been found to belong simply to the elements calcium, sodium and silicon, which elements have been sputtered on the anticathode from some parts of the tube by the presence of argon. The *L*-series of argon have been measured with reference to the lines of boron[9], and the following values have been obtained

	λ	ν/*R*	ν/*R* cal.
L_e	56·1	16·2	16·29
$L\eta$	56·7	16·1	16·13

The observed values (measured in the second order) agree well with those calculated by interpolation of the data from Siegbahn and Magnusson[10]. We have not succeeded hitherto in obtaining a distinct character of the absorption edge of argon. The short wave limit of these lines is 54·0 A., which differs from the value given by Holweck (50·1 A.) and by Turner (50·7 A.) by about 3 A. Our results show that, with certain modifications of our arrangement, such a pressure is obtainable that we can expect the above mentioned absorption edges of argon, as well as of other gases, in the region of long wave-lengths.

M. BAČKOVSKÝ.
V. DOLEJŠEK.

Spectroscopical Institute
of the Charles University,
Prague.
Sept. 16.

[1] A. Dauvillier, *C.R.*, Paris, **191**, 937; 1930.
[2] H. Fricke, *Phys. Rev.*, **15**, 202; 1920.
[3] Y. D. Hanawalt, *Phys. Rev.*, **37**, 715; 1931.
[4] D. Coster and Van der Tuuk, *Z. Phys.*, **37**, 367; 1926. NATURE, **117**, 586; 1926.
[5] V. Dolejšek and V. Kunzl, *C. Y. M. Fys.*, **61**, 242; 1932. *Z. Phys.*, **74**, 565; 1932.
[6] J. Thibaud, *J. Phys. et Rad.*, **8**, 447; 1927.
[7] V. Kunzl and J. Slavík, *Z. Techn. Phys.*, August, 1935.
[8] V. Kunzl, NATURE, **136**, 437; 1935.
[9] M. Siegbahn and T. Magnusson, II, *Z. Phys.*, **87**, 305; 1935.
[10] M. Siegbahn and T. Magnusson, IV, *Z. Phys.*, **95**, 149; 1935.

Dipole Moments of Ethyl and *Iso*-amyl Borates and Triphenyl Phosphate

SOME months ago we commenced an examination of the dipole moments of esters of inorganic acids.

Otto[1] has now published the dipole moments of *n*-butyl borate and *n*-amyl borate as 0·77 D and 0·79 D, respectively, at 25°, in benzene. We have found that ethyl and *iso*-amyl borates have moments of 0·75 D and 0·81 D, respectively, at 20°. The values for *n*- and *iso*-amyl borates are, therefore, in good agreement, and there seems to be a slight increase in the moment in ascending the series of alkyl groups. Triphenyl phosphate has, we find, a moment of 2·79 D.

The borates were fractionated several times, and the triphenyl phosphate recrystallised twice from petrol ether. As the borates are extremely easily hydrolysed, great care was necessary to avoid exposure to air. The dielectric constants were measured by the apparatus previously used[2], except that a glass dielectric cell containing platinum plates, the inlet and outlet tubes of the cell being fitted with ground glass caps, was employed. Benzene was the solvent and all the measurements were at 20° C.

The results were :

Compound	B. Pt.	d_4^{20}	n_D^{20}	P_{∞}	P_E	μ
Ethyl Borate	119·2°/756 mm.	0·8635	1·3741	50·5 c.c.	38·63 c.c.	0·75 D
Iso-amyl Borate	256·1°/761 mm.	0·8514	1·4156	94·3	80·20	0·81 D
Triphenyl phosphate	49·8° (M.Pt.)			252·5	87·41[3]	2·79 D

Work is in progress on other esters, and the results will be discussed when the measurements have been completed.

E. G. COWLEY.
J. R. PARTINGTON.

Queen Mary College,
University of London.
Sept. 13.

[1] Otto, *J. Amer. Chem. Soc.*, **57**, 1477; 1935.
[2] Cowley and Partington, *J. Chem. Soc.*, 604; 1935.
[3] Value calculated from sum of atomic refractions for D line.

Structure and Oxidation of Nitrogenous Substances

IT has been reported elsewhere[1] that organic nitrogen in plant materials, soil organic matter and extracted proteins undergoes partial oxidation to nitrate on treatment with a mixture of sulphuric and chromic acids. It has since been found that the proportion of total nitrogen recovered as ammonia is constant for each substance, provided the oxidation is completed under conditions of reduced pressure and moderate temperature[1], and sufficient of the substance be taken to contain more than 20 mgm. of nitrogen. Of the fraction not recovered as ammonia, a portion is oxidised to nitrate and the rest is lost in gaseous form, probably as nitrogen or nitrous oxide. The 'oxidation constants' bear definite relationship to the structure of the compound.

While, in the case of compounds having nitrogen atoms attached to different carbon atoms, full recovery of nitrogen is obtained in the form of ammonia and nitrate, a definite portion is lost in gaseous form with compounds having two or more nitrogen atoms linked to the same carbon atom. The proportion of ammonia recovered from some typical groupings are as follows: –NH–CO–NH– group, 2/3 of total nitrogen; $CH\lessgtr^{N<}_{N-}$ group, 4/5; guanidine group, 4/11; creatine group, 2/3. The hydroxylamine derivatives are almost quantitatively oxidised to nitrate, while the nitrogen in hydrazine derivatives is almost completely lost in gaseous form.

Chlorides present as impurity in commercial samples and as hydrochlorides of bases tend to increase the proportion of nitrate formed at the cost of ammonia, and should be removed by precipitation with Ag_2SO_4. The possible significance of these 'oxidation' constants in relation to the structure of complex substances, for example, proteins, is under examination.

C. N. ACHARYA.

Rothamsted Experimental Station,
Harpenden, Herts.
Sept. 18.

[1] *Proc. Biochem. Soc., J. Soc. Chem. Ind.*, **54**, 596; 1935.

Phonemes

THE terminological confusion which has long plagued linguistic study has latterly been particularly acute in the matter of the phoneme. The recent communication[1] of Prof. E. W. Scripture does not appear likely to improve the situation.

Prof. Scripture proposes to apply the term 'phoneme' to "one of a group of similar sounds". Hitherto, the term has been used as referring to the group itself, as including the various similar (that is, only slightly different) sounds which were regarded then as 'members of a phoneme'. Prof. Scripture's proposal leaves unspecified the group itself; and it is precisely the inclusive, aggregational property which is most important. Prof. Scripture would call the *t* of *tip* a phoneme, and the *t* of *pit* another phoneme; but he has no name to apply to the group which includes these and all other *t*'s.

This departure from the small measure of agreement which has been reached on the phoneme might be justified, of course, if Prof. Scripture could adduce valid evidence of the usefulness of this innovation. But there is patently no advantage in shifting the application of a term from a group to an individual member of the group. The essential problem is the determination of the group[2]. Only if Prof. Scripture has some new and more successful procedure for sorting all the sounds of a language into definite and mutually exclusive categories can his proposal be considered seriously.

Prof. Scripture believes "that phonemes do exist", and thus takes his stand with those who hold that a phoneme is (or corresponds to) an observable physical reality of some order. This reality Prof. Scripture finds in sound-track recordings. His position thus corresponds in certain essential respects to that which Bloomfield developed more fully in his "Language". But Prof. Scripture does not indicate how the "group of sounds" are to be determined, aside from a casual assurance that "On comparing the records we find that groups of similar speech sounds can be formed". Thus far, I know of no evidence from the laboratory that records of *tip* and *pit* will show physical peculiarities to justify grouping together the *t*s or the *p*s on the basis of positive similarity. For to group together the *t*s on this basis presupposes not only the discovery of positive similarities as among various kinds of *t*s but also the determination of some physical peculiarities associated only with *t*s. The group can be established on a laboratory basis only by the discovery of characteristics which are constantly present for this group, and never present for any other group.

Prof. Scripture cannot be unaware of the objections raised to Bloomfield's essentially similar proposal, and it is impossible that his suggestion in NATURE should have been made jocosely or irresponsibly. One can only conclude that he has discovered a method for the determination of positive, exclusive physical properties of the various members of a phoneme (in his terminology, the various phonemes of a group). The announcement of his discovery will be welcomed as a partial solution of this vexing phonetic-phonological problem.

Still unsolved, however, will be the problem of differing phonemic distributions of similar sounds in different languages. Recordings of an American pronouncing *battle* and an Englishman pronouncing *barrel* would show a high order of similarity in the intervocalic consonant, which belongs definitely in a *t*-group for the American and in an *r*-group for the Englishman.

W. F. TWADDELL.

University of Wisconsin,
Madison, Wisconsin.
Sept. 3.

[1] NATURE, **136**, 261, Aug. 17, 1935.
[2] Cf. *Language Monograph*, **16**, 17–32.

IN a collection of sound film registrations I find quite a number of regions that resemble the one reproduced in Fig. 1. Such a region consists of a series of bits of vibration with many peaks of different heights and periods of repetition and several vibratory movements of less sharp character, all of them beginning strong and fading to zero. Each bit of vibration can be characterised by its duration and by the systems of peaks and less sharp movements with their heights, periodicities and decrements. An entire region will be characterised not only by all the measurements for the individual bits but also by the numbers for their differences and order of sequence. Every region will have a more or less similar, but yet different, set of numbers for each of its characteristics.

For the group formed from the similar cases there will be for each characteristic an average value a, an average variation v and a limit of variation l. For the whole set of i characteristics there will be the averages $a_1, a_2, \ldots, a_i$, the average variations $v_1, v_2, \ldots, v_i$, and the limits of variation l_1 $l_2, \ldots, l_i$. The term 'phoneme' might be used to indicate: (1) the whole group of speech sounds with

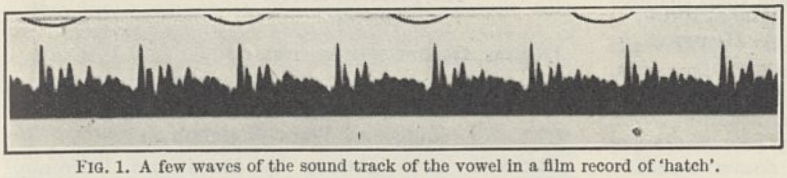

FIG. 1. A few waves of the sound track of the vowel in a film record of 'hatch'.

characteristics specified in this way, or (2) a speech sound defined with averages of these characteristics, or (3) a speech sound that may be any one of the group with these characteristics. The choice depends on convenience and accuracy. If we say that a person pronounced the word indicated in print by *hatch* with the phoneme æ, we do not mean that he used a whole group or an average; we can only mean that he used one of a group. If, however, we say that the speech of a person or a dialect is characterised by the use of the phoneme æ, any one of the three meanings is appropriate.

The essential point is that a new and successful method does exist for accurately and minutely specifying and sorting all the sounds of a language into definite and mutually exclusive categories, namely, the measurement of records of speech. This method transforms phonetics and linguistics from indefinite disciplines into exact sciences. It must be understood that science deals only with observables (Heisenberg) and that our knowledge is limited to the numbers obtained from the observables (Eddington and others). The entities that produce these numbers are not only unknowable but are also unmeasurable (Dirac). A statement that a speech sound consists of a certain set of measurement-numbers is a scientific fact that can be used. A statement that it is like the sound of *t* in *tip* conveys no definite information unless the measurement-numbers are given. If we mean anything else than these measurement-numbers we are claiming knowledge of the unknowable.

E. W. SCRIPTURE.

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London, E.15.

Mechanism of Glyoxalase Activation by Glutathione

WE have investigated the specific co-glyoxalase action of glutathione, discovered by Lohmann[1]. Giršavičius and Heyfetz[2] have shown that the spontaneous combination of glutathione and methyl glyoxal in aqueous solution leads to a state of equilibrium; formation and dissociation of the compound proceed, in not too acid solution, with great rapidity. The dependence of the velocity of the enzymic reaction on the initial concentrations of glutathione and methyl glyoxal (Platt and Schroeder[3]) and of their compound (unpublished work of ours) leads to the conclusion that of the three substances—free glutathione, free methyl glyoxal, and the compound—it is the latter that is the true substrate of glyoxalase action (though one of the other two may also be playing a part).

It is a striking fact that although widely differing reaction velocities are obtained when different initial concentrations of glutathione and of methyl glyoxal are used, yet *at all concentrations and velocities* the reaction proceeds linearly (zero order) until almost complete exhaustion of the methyl glyoxal. To shed some light on this fact, unusual in enzyme kinetics, we followed the changes in free sulphydryl in the course of the reaction. The lactic acid production by the enzyme was determined by gradual titration with alkali, the hydrogen ion concentration of the buffer-free solution, which contained an indicator, being kept constant. From time to time, samples were strongly acidified and rapidly titrated with iodine in presence of starch. We expected a gradual reappearance of the glutathione originally bound to methyl glyoxal. The results actually obtained are shown in Fig. 1. The greater part of the initially present free glutathione (less than half of the total; the rest is combined with methyl glyoxal) rapidly disappears after addition of the enzyme. The amount of free —SH group of the glutathione remains at a low value during most of the reaction; finally, as the reaction comes to an end and its velocity begins to fall, all the —SH, including that originally combined, rapidly reappears again. All the while the acid production proceeds at a steady rate.

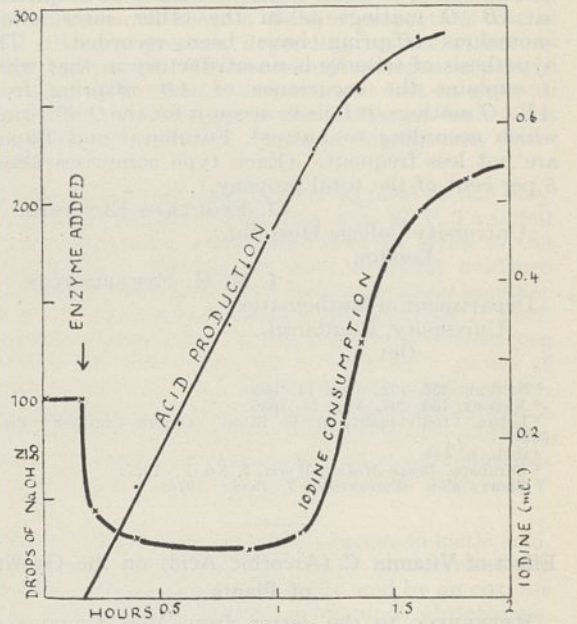

FIG. 1.

We have not yet investigated how the glutathione is 'hidden' during the reaction. A more complete combination with methyl glyoxal under the action of the enzyme (less than 0·5 mgm. of a purified preparation in 1 mol.) would appear to be ruled out by the chemical equilibrium involved. A dismutative reaction, with intermediate formation of other substances than lactic acid, is contradicted by the observation of Ariyama and Kobayashi[4] that lactic acid production is equal to loss of methyl glyoxal throughout the reaction.

Whatever the actual chemical reactions involved, it can be stated in general terms that the glutathione first combines by means of its —SH group with the substrate, methyl glyoxal, and then, as the enzyme-catalysed reaction develops, enters into some further transformations, again involving its —SH group. This observation seems of interest for the role of sulphydryl compounds in biochemical catalysis generally.

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Moscow.

[1] *Biochem. Z.*, **254**, 332; 1932.
[2] *Biochem. Z.*, **276**, 190; 1935.
[3] *J. biol. Chem.*, **104**, 281; 1934.
[4] *J. Biochem.* (Tokyo), **16**, 317; 1932.

Blood Group Inheritance

WE agree with Prof. Haldane's view[1] that the existence of a fourth allelomorph underlying the inheritance of blood groups (equivalent to the theory proposed by us[2]) cannot be regarded as proved until tested in some such way as he suggests. The published statistics of many investigators, collected by Lattes[3], do not give sufficient information about individual families for the points raised by Prof. Haldane to be dealt with immediately.

Of the alternative theories suggested, mutation is discounted for the reason Prof. Haldane surmised: it would need to occur about ten times as frequently in $AB \times O$ matings as in the other cases where anomalous offspring have been recorded. The hypothesis of trisomy is unsatisfactory in that while it explains the occurrence of AB offspring from $AB \times O$ matings, it fails to account for the O offspring, which according to Lattes[4], Furuhata[5] and Bauer[6] are not less frequent. (Each type comprises about 5 per cent of the total progeny.)

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I. M. H. ETHERINGTON.
Department of Mathematics,
University, Edinburgh.
Oct. 2.

[1] NATURE, **136**, 432, Sept. 14, 1935.
[2] NATURE, **136**, 297, Aug. 24, 1935.
[3] Lattes, "Individuality of the Blood" (Oxford University Press, 1932).
[4] ibid., p. 149.
[5] Furuhata, *Japan Medical World*, **7**, No. 7; 1927.
[6] Bauer, *Klin. Wochenschr.*, **7**, 1588; 1928.

Effect of Vitamin C (Ascorbic Acid) on the Growth of Plants

REFERRING to the letter from Miss Synnöve v. Hausen[1], I gladly acknowledge the priority of her paper, the existence of which was unknown to me when publishing mine on the same subject. Such coincidences are frequent in research work. More important, however, than similar questions of priority is the fact that our experiments have resulted, in a new field of research, in mutual confirmation, although worked out independently and with different methods.

There is yet another point which I wish to stress, and that is: the new proof given of the great utility of the 'correspondence' columns of NATURE in giving early news in the field of research and in bringing together research workers who would not otherwise know of each other's work. This is particularly the case with publications in languages which are read by relatively few people outside the countries in which they are used.

LÁSZLÓ HAVAS.
Rothamsted Experimental Station,
Harpenden, Herts.
Oct. 3.

[1] NATURE, **136**, 516, Sept. 28, 1935.

Zinc and Plant Metabolism

RECENT investigations by Reed and Dufrénoy[1] on the condition known in *Citrus* culture as 'mottle-leaf' are of great interest to the plant physiologist apart from their practical value to the industry. Results obtained from field treatments in conjunction with microchemical examination have suggested that zinc plays an important role in controlling the oxidation-reduction equilibrium of the leaf cells. Application of zinc, either through the soil or in the form of a spray to the foliage, leads to rapid recovery from the 'mottled' condition, associated with profound cytological changes including the production of chlorophyll.

During a visit to California in the early part of this year, I was fortunate in seeing these experiments. The contrast between the yellow-leaved control trees and those that had been sprayed a few months previously with zinc sulphate solution and were now bearing dark green, healthy foliage was truly striking. There can be no question as to the efficacy of the treatment, surprising though it may be that effective amounts of zinc can be absorbed by leaves with a cuticle so thick as that of *Citrus*.

It would be regrettable if these investigations, through their publication in a periodical mainly devoted to agricultural science, should escape the attention they deserve from plant physiologists who may have no direct contacts with applied work.

W. NEILSON JONES.
Bedford College,
University of London.
Oct. 3.

[1] H. S. Reed and J. Dufrénoy, "The Effects of Zinc and Iron Salts on the Cell Structure of Mottled Orange Leaves", *Hilgardia* (Univ. of Calif., Berkeley, Calif.), **9**, 113–135; 1935.

Prevention of Clogging of Strainers in Rearing Aquatic Organisms

WALTON SMITH has recently[1] described apparatus which overcomes several difficulties in rearing marine larvæ in flowing water, one special point being the waxing of the bolting silk strainers to retard clogging. I encountered the clogging in rearing *Metriocnemus longitarsus*, Goet. (Diptera, Chironomidæ) larvæ in flowing water, the overflow strainer being rapidly stopped up by the algal food and dejecta.

A 500 c.c. distilling flask was provided with a rubber bung through which passed a short 4 mm. bore glass tube as inlet, its inner end closed with a strainer, as these larvæ attempt to leave their vessel. A second piece of tube was bent to an appropriate angle and one limb cut off very short. The short limb was fixed tightly into the inner end of the delivery tube of the flask by a rubber

ring and the long limb projected into the body of the flask, but not directly below the inlet tube. Its lower end was just clear of the surface when the flask was half-filled with water and was closed by a fine strainer, thin cotton cloth being used as the larvæ nibbled bolting silk and so escaped. A rubber connexion between the inlet tube and a cistern was supplied with a screw clamp to regulate the flow, which fell in heavy drops.

The wave caused by the drop made contact with the outlet strainer and ejected an equal amount of water while the suction of the falling wave kept the strainer from clogging. The drip was adjusted to renew the water in the flask every four hours, but a faster renewal is possible just so long as the 'make and break' system persists. As tap-water served my purpose, the cistern was kept supplied from a gently running tap, four flasks working from a single main lead, and, provided that air locks were not allowed to form in this lead, the apparatus ran smoothly for an indefinite length of time.

LL. LLOYD.

The University,
Leeds.
Oct. 1.

[1] NATURE, **136**, 345; 1935.

X-Ray Examination of the Effect of Removing Non-Cellulosic Constituents from Vegetable Fibres

IN a recent letter by W. T. Astbury, R. D. Preston and A. G. Norman in NATURE of September 7, p. 391, it is stated that "Miles Thomas and Hewitt report a diminished *intensity* in photographs of purified fibres; but we have not observed such an effect".

The results obtained for sisal, in this laboratory, confirm their statement that *no* diminished intensity is observable in photographs of *purified* fibres. On the contrary, the process of purification leads to an improved definition.

Any ambiguity which may have existed on this point is much to be regretted, but it may be easily explained and removed.

Fibres which have been chlorinated by the use of moist chlorine gas, and the so-formed chloro-compounds not removed, were designated "chlorinated fibres". It is these fibres which give a photograph of diminished intensity. There is full agreement as to there being no diminished intensity in photographs of purified fibres.

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Leicester.

Points from Foregoing Letters

CERTAIN strains of mosquitoes (*Culex pipiens*) originally found on the Continent can lay fertile eggs without a previous meal of blood and have been termed 'autogenous'. J. F. Marshall and J. Staley bring evidence that certain man-biting mosquitoes in Great Britain are females of such autogenous strains: they describe the morphological differences between autogenous mosquitoes from various countries and the original non-autogenous variety and suggest that the specific name *C. domesticus* be revived for the autogenous strain.

The original gorilla skulls upon which Richard Owen based his first description of that animal in 1848 have been discovered in the Bristol Museum and Art Gallery. H. Tetley gives their origin and history.

The formation of brown ring deposits on glass by bombardment with positive rays (protons) is reported by Prof. B. Dasannacharya, V. T. Chiplonkar and L. G. Sapre. Similar deposits, but not ring-shaped, have been observed before and ascribed to the decomposition of hydrocarbon impurities.

Dr. R. K. Asundi, M. Jan-Khan and Prof. R. Samuel have increased the small number of completely analysed spectra of polyatomic molecules by an analysis of the SeO_2 bands. They have also analysed the SeO bands, and find a close correspondence between the constants of these two molecules, which indicates strong localisation of the bonds.

The direct measurement of the *L*-series of the X-ray spectrum of the rare gas argon, by means of their new ionic tube, is reported by M. Bačkovský and Prof. V. Dolejšek. The observed values agree well with those calculated by interpolation of the data from Siegbahn and Magnusson.

E. G. Cowley and Prof. J. R. Partington have determined the dielectric constants of several esters of inorganic acids (ethyl and *iso*-amyl borates and triphenyl phosphate) and have calculated their molecular dipole moments.

Experiments by Dr. C. N. Acharya show that, when nitrogenous substances are oxidised by a mixture of chromic and sulphuric acids, the amount of ammonia formed bears a definite proportion to the total nitrogen present, depending on the structure of the compound. Of the residual nitrogen, a part is converted into nitrate, and the rest lost in gaseous form. Dr. Acharya gives the values of 'oxidation constants' for different types of nitrogenous compounds.

If the term 'phoneme' is to be applied to one only of a group of similar sounds then, asks W. F. Twaddell of Prof. Scripture, what name is to be given to the group itself? Further, is there sufficient evidence from sound-track profiles to justify grouping together the *p*'s or *t*'s in such words as '*pit*' and '*tip*'? Prof. Scripture answers that it is a matter of convenience whether the term phoneme is used for a group of similar sounds or for a single member of the group. The essential part, he insists, is that the phoneme shall be defined in quantitative terms based upon film-tracks or similar records, and not upon references to undefinable and unrecorded sounds such as '*t*' in '*tip*'.

In the fermentation of certain sugars to lactic acid, methyl glyoxal is considered to be an intermediary product, it being changed to lactic acid by an enzyme in presence of the sulphur compound, glutathione. From the rate at which lactic acid is produced and from other evidence, J. Giršavičius and P. A. Heyfetz conclude that the glutathione first combines by means of its —SH group with methyl glyoxal, and then, as the enzyme-catalysed reaction develops, enters into a further transformation, again involving its —SH group.

Prof. Neilson Jones directs attention to recent work by Reed and Dufrénoy showing that spraying with zinc sulphate prevents 'mottle leaf' in *Citrus*, and points out that zinc is apparently an essential element in the production of chlorophyll.

Research Items

Recent Cave Exploration in Britain

AT the recent Norwich meeting of the British Association, reports of two committees of Section H (Anthropology) dealt with explorations of caves in Britain which have been subsidised by the Association. Of these, the report on the work carried out in Kent's Cavern, Torquay, indicates that during the past year a stage of excavation has been reached which promises well for future results, though at an enhanced expense. The work of the past year, which was resumed in October, 1934, and continued until the end of May, 1935, was directed to the centre of the Vestibule at the north entrance, which has been the scene of operations of the last three seasons. It proved most remunerative in the quantity and size of the animal relics, among them being the tibia of an Irish elk, believed to be the largest ever found in the cave, a very long rib of a rhinoceros, a well preserved tooth of a mammoth, and the whole of the incisors of a horse. These bones were remarkably free from the gnawing of carnivores. Probably they had dropped between the interstices of the large fragments of rock, with which the floor had then been covered, and thus escaped the further attention of the hyænas by which they had been brought to the cave. In the Creswell Caves of Derbyshire, which have now been under exploration by Mr. A. Leslie Armstrong on behalf of the Association Committee for some years, a section showing the stratification of the deposits in the cave has been prepared for permanent preservation. It is announced that application has been made to the Office of Works for the cave to be preserved and maintained as an ancient monument. In the meantime, Mr. Armstrong has begun work on the deposits at the entrance of the cave, with the view of penetrating to the two Mousterian levels underlying the superficial levels which were all that were examined by the Rev. Magins Mello in 1875. Valuable additions have been made to the fauna and artefacts from Mother Grundy's Parlour. It is now proposed to excavate the Boat House Cave.

Influence of Illumination on Work-Efficiency

A JOINT report of the Industrial Health Research Board and the Illumination Research Committee gives the result of an investigation by H. C. Weston into the relation between illumination and efficiency in work (H.M. Stationery Office, 1935. 4*d*. net). This report describes the first experiment, and deals with the illumination necessary for different sizes of work. Eighteen men were given sheets of paper on which were printed rows of incomplete circles. The gap in each circle pointed a different way, and each of the several sheets had different sized circles and gaps. The men had to cancel the circles in which the gap pointed a certain way. The same tests were given in six different degrees of illumination. Conditions were controlled so that there was no chance of memorising, no violent change in illumination, the minimum fatigue, and full allowance for individual variations. The results were judged according to the speed and accuracy of the subjects' discrimination alone. They show that although the smallest size could never be seen as easily as the largest, the right illumination obtained the maximum performance for each size. A change in size among the smaller and the larger sizes necessitated less alteration in illumination than a change among the intermediate ones. The range of illumination found necessary in the test is easily obtainable in practice.

Adaptation in *Artemia salina*

THE report submitted to Section D at the Norwich meeting of the British Association by the Committee, of which Prof. R. A. Fisher was chairman and Dr. F. Gross secretary, appointed to investigate the progressive adaptation to new conditions in *Artemia salina* (diploid and octoploid, parthenogenetic and bisexual), describes some highly suggestive experiments. Treatment of different races of *Artemia salina* with sodium arsenite showed a considerable difference in susceptibility between the diploid bisexual and the octoploid parthenogenetic forms. Of the latter, several lines showed 100 per cent survival of nauplii, when tested for twenty-four hours at the age of 1–4 days with 0·6 per cent of an $N/10$ solution of sodium arsenite, whereas in the bisexual races even the 50 per cent point of survival lies well under 0·5 per cent poison. In the bisexual races, parallel families showed consistently different degrees of resistance, although, as shown in the report, there were irregularities in the response of different broods of the same parentage, the cause of which has not yet been established. As regards the question whether there was any increase in resistance due to treatment and selection, comparisons were made which indicate in both a parthenogenetic line and in bisexual strains, a higher percentage of surviving nauplii after one and two generations treatment. "In both cases it is difficult to avoid the conclusion that the strength of poison needed to produce a given death-rate has been increased by at least 10 per cent., and probably more for the bisexual material."

Crabs from the Dutch East Indies

DR. ISABELLA GORDON has described in detail a collection of crabs from the Dutch East Indies ("Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique". *Mémoires du Musée royal d'histoire naturelle de Belgique*. Hors Série, 3, Fasc. 15. 1934. Crustacea Brachyura). The material includes several uncommon and interesting forms. The genus *Phymodius* is revised and *P. monticulosus* separated from *P. ungulatus* as a distinct species. The sub-family *Eumedoninae* in the family *Parthenopidae*, and the genus *Xenocarcinus* are also revised. The text-figures in this work are good and, especially in the drawings of the male pleopods, show an extraordinary amount of different types. These male pleopods in many genera are found to be of much specific importance and are a valuable diagnostic character, differing as they do very appreciably in those forms in which they are used for systematic work. Further reports in the same series recently published include the Rhizocephala and the Stomatopod larvæ.

After-Ripening and Germination of Rose Seeds

THE propagation of garden roses by budding good varieties upon stocks raised from seed is likely to find extensive application in the near future. Rose seeds are, however, rather difficult to germinate, but a paper by Dr. M. A. H. Tincker (*Roy. Hort. Soc. J.*, 60, Pt. 9, Sept. 1935) shows that suitable storage conditions before planting will render propagation from seed much easier. Achenes from the rose hips should be scattered in layers in damp sand within a plant pot which is then sunk in ashes in the open. This process is known as 'stratification', and if the seeds remain under these conditions from early November to the beginning of March, subsequent germination is hastened considerably. The paper reports a number of trials of unsuitable methods, the results of which are, nevertheless, illuminating. Storage at low or cool temperatures, for example, did not hasten germination; the seeds apparently require fluctuations in temperature and moisture content such as are provided by stratification.

A Virus Disease of Wallflowers and Stocks

GARDENERS are now familiar with the pathological condition of the tulip known as 'breaking', and it is interesting to note that wallflowers and stocks are subject to a similar malady ("Colour Changes in Wallflowers and Stocks" by Dr. Kenneth Smith, *Gard. Chron.*, 112, Aug. 10, 1935). The cause of the trouble is a virus disease of cauliflower and broccoli. This produces a mottling of diffuse yellow patches on the leaves, and such plants serve as sources of infection for wallflowers and stocks, the aphid *Myzus persicæ* being the transmitting agent. The last-mentioned floral crops have mottling of the leaves, but their flowers are also streaked with white or yellow—a most conspicuous and bizarre effect. Control measures are routine spraying of young plants with a wash to kill the aphids, the destruction of any infected plants, and the separation of the culinary members of the Cruciferæ from the beds with wallflowers and stocks.

Nevada Earthquake of 1934

EARTHQUAKES of moderate intensity are very rarely accompanied by superficial fault-displacements, and thus the account given by Messrs. E. Callaghan and V. P. Gianella of the earthquake of January 30, 1934, in the Excelsior Mountains, is of much interest (*Bull. Amer. Seis. Soc.*, 25, 161; 1935). The shock was of intensity 8 or 9 (modified Mercalli scale) and its epicentre lay in about lat. 38·2° N., long. 118·6° W. Numerous faults traverse the mountain area, and, along one of them on the southern slope and directed N. 66° E., a rupture occurred, about 4,500 ft. in length, with a scarp 5 in. in maximum height, showing that the summit area of the range had subsided with reference to the southern side.

Wind Records in Open Sea

"WIND Records from the Bell Rock Lighthouse", by A. H. R. Goldie, is the title of Geophysical Memoir No. 63 of the Meteorological Office (H.M. Stationery Office. 2*s*. 6*d*.). A Dines anemograph was erected at the Bell Rock in 1929, fourteen feet above the dome of the lighthouse, and 130 ft. above the mean level of the sea; the position, twelve miles from that part of the east coast of Scotland in the neighbourhood of Arbroath, is unique for its representation of open-sea conditions. Nevertheless, the detailed analysis of records obtained in the first two years during which the instrument was working, and their comparison with similar records obtained on the very exposed island of Tiree, suggest that the Scottish mainland is not without its influence on the structure of the wind, even at that distance. The absence for a great distance in all directions of any objects except the sea waves that might cause gustiness by mechanical friction leads one to expect low figures for the 'gustiness'—defined as the difference between the average wind speed in gusts and in lulls divided by the mean speed. The analysis showed that gustiness is greater in winter than in summer, an effect attributed by the author to the greater lapse-rate of temperature in winter. The memoir contains a section dealing with wind waves and squalls which is of particular interest in view of the work done at Cardington on the cell structure of squalls. There appears to be very strong evidence that wave-like fluctuations of wind speed at Bell Rock are nearly always associated with marked horizontal stratification of the atmosphere, while squalls of the type where the wind speed increases very suddenly with a veer of direction and falls off gradually (a feature of the convexional cells found at Cardington) are associated with a steep lapse-rate of temperature.

A Device for Stream Field Study

IN a paper communicated by the Structural Research Laboratory of the Royal Technical College, Copenhagen (Ingeniørvidenskabelige Skrifter. *A*, Na. 39: A New Device for Direct Stream Field Studies and its Application: with an Appendix on the Pressure Distribution on a Triangular Prism. By Paul Neményi. Pp. 23. Copenhagen: G. E. C. Gad. 3.00 kr.), Paul Neményi describes a new device which he has designed for stream field studies, and gives details of its application to the determination of wind pressures on buildings. Recent investigations have shown that with small roof slopes there is a partial vacuum on the windward side, and that when the slope becomes steeper this condition changes somewhat abruptly to pressure. The results obtained from experiments made in the Ahlborn Channel being to an unknown extent influenced by capillary phenomena, it was thought desirable to check and correct these by constructing a closed channel with measuring arrangements to give the direction of the stream, the total velocity pressure and the static pressure. The wind channel is horizontal, and across it is placed a horizontal tube having an almond-shaped section with a single hole in the symmetry axis of the central section. This tube can be raised from bottom to top of the wind channel, and can also be turned through any angle so that the pressure and its direction can be taken at any height in the central plane of the channel. The paper provides an illustration and description of the channel and measuring apparatus, and proceeds to describe a number of typical experiments made on models representing solid and perforated walls and buildings, and on a triangular prism. Diagrams show the pressure distributions obtained in these experiments both in the form of contour maps and cross-sections for various directions of the wind relative to the surfaces. These diagrams exhibit very clearly the surprisingly high negative pressures which occur locally near roof edges. At one point, for example, the negative pressure was found to be 326 per cent of the normal velocity pressure.

Radio Research in Australia

THE Radio Research Board, which was set up some years ago under the Commonwealth of Australia Council for Scientific and Industrial Research, continues to carry out considerable research into several of the fundamental problems of radio communication. The results of some of this work have recently been described in a series of ten scientific papers published in Melbourne in three reports of the Radio Research Board. A foreword to these reports states that the co-operation of several bodies in Australia has greatly assisted the work of the Board. In particular, the Postmaster General's Department contributed half the cost of the investigations during the financial year 1928–29, and three-quarters of this cost in the succeeding years. The Universities of Sydney and Melbourne have provided the necessary laboratory facilities for the location of the staff conducting the work, while the Department of Defence has also assisted with the loan of apparatus and in other ways. It is to be noted that several of the authors of the papers received their early research training in Great Britain with the Radio Research Board organisation under the Department of Scientific and Industrial Research.

The first report of the series under review contains four papers[1], of which one "On the Rotation of the Plane of Polarisation of Long Radio Waves" has been previously published in the *Proceedings of the Royal Society*, 1934. The other three have also been published previously in the *Journal of the Institution of Engineers, Australia*. Two of these papers deal with the development of a radio field intensity measuring set for medium broadcast frequencies, and its use in the exploration of the field around some Australian broadcasting stations. As a result of this work data have been obtained on the effective conductivity of several types of ground, and the resulting attenuation accompanying the propagation of waves over this ground. At the same time, measurements were made on the intensities of indirect or downcoming waves at various distances, and on the general noise level due to atmospheric disturbances, with the view of determining the effective service range of certain broadcasting stations. The last paper in this series describes the development of a frequency recorder for the rapid and continuous measurement of audio frequencies, as required in an extension of the frequency-change method of determining the heights of reflecting layers in the ionosphere.

Report No. 7 contains a group of four papers describing investigations into the propagation of medium frequency electric waves in the ionosphere[2]. Each of these papers has already been published in Great Britain during 1934 or 1935.

The last of the reports[3] so far received contains two hitherto unpublished papers describing the study of atmospherics and their interference effect in radio reception in Australia. The first of these describes a series of observations of the directions and intensities of atmospherics carried out with two visual cathode ray direction-finders installed at the ends of a base line 570 miles long and operating on a wave-length of 3,000 metres. The sites selected for these instruments, at Canberra and Toowoomba respectively, were considered to be particularly suitable for obtaining data on sources of atmospherics in Queensland. With the aid of a short wave radio communication link, simultaneous visual observations were made over a period of four months, December 1933–March 1934. The results are illustrated in the paper by maps showing the distribution of the sources of atmospherics during this summer period, and also lines of equal mean intensity of disturbance produced by each source.

The location of these atmospherics sources shows a very satisfactory correlation with the reports of thunderstorms obtained from the ordinary meteorological records, and thus strongly confirms the previous deduction that the majority of, if not all, atmospherics in Australia originate in lightning flashes. An important inference made by the authors on this portion of the work is that for thunderstorm warnings for aircraft, the cathode ray direction-finder is much preferable to ordinary meteorological methods.

The shapes of the iso-intensity lines referred to above for daytime observations were found to be satisfactorily explained by the effect of the topography of the ground on the propagation of the electric disturbance constituting the atmospheric. After making allowance for this effect, both the day and night observations agree in indicating that all the sources were of the same mean intensity within reasonable limits ; in other words, the average power in a particular wave-band radiated by lightning flashes is sensibly constant. The distances at which the sources were located ranged up to about 2,500 miles from the observing stations.

The last paper in this series discusses the effect of atmospheric disturbances on broadcast reception conditions in Australia. The equivalent power of the radiation emitted by an average lightning flash is calculated, and the activity and distribution of lightning flashes in thunderstorms in various parts of Australia has been obtained from the meteorological records. With the aid of these data, the interference of atmospherics with the reception of broadcasting on different wave-lengths and at various field intensities has been calculated. Under the conditions considered in the paper, it is concluded that the proportional time of interference with the normal 4,000 hours of broadcasting per annum is very small. In the foreword to this report (No. 8) it is pointed out that some matters in this paper, such as the standards of reception assumed, may not be generally accepted by other experts on this subject.

[1] A. L. Green and G. Builder : "On the Rotation of the Plane of Polarisation of Long Radio Waves" ; A. L. Green and N. B. Wood : "A Field-Intensity Set" ; G. H. Munro and A. L. Green : "Measurements of Attenuation, Fading and Interference in South-Eastern Australia at 200 Kilocycles per Second" ; D. F. Martyn and H. B. Wood : "A Frequency Recorder". Radio Research Board, Report No. 6, Melbourne 1935.

[2] D. F. Martyn : "The Propagation of Medium Radio Waves in the Ionosphere" ; D. F. Martyn and A. L. Green : "The Characteristics of Downcoming Radio Waves" ; V. A. Bailey and D. F. Martyn : "The Influence of Electric Waves on the Ionosphere" ; D. F. Martyn, R. O. Cherry and A. L. Green : "Long Distance Observations of Radio Waves of Medium Frequencies". Radio Research Board, Report No. 7, Melbourne 1935.

[3] G. H. Munro, H. C. Webster and A. J. Higgs : "Simultaneous Observations of Atmospherics with Cathode Ray Direction-Finders at Toowoomba and Canberra" ; W. J. Wark : "Atmospheric Interference with Reception". Radio Research Board, Report No. 8, Melbourne 1935.

National Smoke Abatement Society

MEETING AT BRISTOL

THE annual conference of the National Smoke Abatement Society was held in Bristol on September 20–21 under the presidency of Dr. H. A. de Voeux. Dr. A. G. Ruston summarised the work done with the late Prof. J. B. Cohen on the damage caused by smoke in the West Riding of Yorkshire. Animal, as well as vegetable, life suffers. Land exposed to acid atmosphere becomes deficient in lime, and cows grazing on such land yield milk also deficient in lime.

Dr. R. Lessing reviewed sources of atmospheric pollution, and advocated systematic surveys. The generation of electricity in large units, while diminishing total pollution, has resulted in the localised emission of exceptionally large quantities of acid flue gases, often in thickly populated areas. The concentration of fuel burning has the advantage of facilitating efficient utilisation and also the scientific treatment of the flue gases. Within a few years, two processes have been elaborated for the desulphurisation of flue gases, in the Battersea and Fulham Power Stations. The Fulham process has the advantage of producing no liquid effluent. Dr. Lessing estimates that both processes, when in full operation, will reduce the sulphur acids passed annually into the London atmosphere by 40,000 tons. The London gas companies already recover, during gas purification, sulphur equivalent to 55,000 tons of acid. It may be estimated that the public utilities will eventually recover or remove 20 per cent of the sulphur present in the coal burnt in London.

Large power stations emitting flue gases at a high velocity may be an important source of grit and dust, which is an insidious but noxious polluting agent. Fortunately, the washing process also takes care of the grit and dust at the same time. Central heating of large buildings, institutions, blocks of flats is leading to analogous conditions of local atmospheric pollution on a smaller scale.

Hitherto, efforts to diminish atmospheric pollution have been due mainly to idealists possessing knowledge and vision but impotent to alter actual conditions. Those wielding political power, local and national, have been indifferent. Commercial interests have been passively or actively resistant. Conditions, however, change. Already it is recognised that smoke endangers air traffic, and may render a site ineligible for aerodromes. A recent report of an investigation conducted at Pittsburgh expressed the view that "Smoke is a major obstacle to the popularisation of aviation". Atmospheric pollution is largely responsible for the movement of urban population to the country, and this promotes 'ribbon development'. Smoke may make a district unsuitable or unattractive for new industries. The realisation of this by local authorities and chambers of commerce ought to engender a more active interest in ameliorative measures.

Problems of Administration and Management

PROBLEMS of amalgamation and decentralisation were discussed at Norwich on September 9 by the Department of Industrial Co-operation of the Economic Science and Statistics Section of the British Association. Mr. L. Urwick opened the discussion with a paper on executive decentralisation with functional co-ordination in which he emphasised the necessity for a technical approach to questions of organisation. After discussing the nature of responsibility, and its relation to authority and power, he pointed out that reasons of time and space as well as psychological factors were important influences making for decentralisation. The steady and inevitable growth of functional specialisation made imperative the clear distinction between executive and administrative or policy-making responsibility, as well as the co-ordination of functional methods, and the reconciliation of these two tendencies was the central problem in modern business organisation. Failure to recognise the nature of the difficulty might easily involve the failure of a business combination. When a new duty arose, Mr. Urwick insisted that the only ultimate solution was to define that duty and assign it to individuals, properly selected and suitably trained. He regarded it as inevitable that business organisation should evolve towards a true system of 'staff' positions and relationships as distinct from either 'line' or 'functional' positions, and organised staff training was accordingly essential.

Mr. T. G. Rose described some examples of decentralisation problems in small undertakings, particularly of the management difficulties arising with a head office in London and works in the provinces, or in financial control from London while management and manufacturing activities are carried on in the provinces, or again in the decentralisation of management in a group of rationalised small firms.

Dr. K. G. Fenelon discussed problems of centralisation and decentralisation in the management and administration of combines. A choice between these two alternatives in practice has usually been made on an empirical basis, and frequently following an initial centralisation, a complete reorganisation had been undertaken to achieve decentralisation on a scientific basis. Such a task of reorganisation involves the careful study of each of the different functions and activities and the determination of the most suitable organisation for each. This reorganisation accordingly involves three stages : first the bringing of all the threads into the hands of the central management for the study of the problems and procedure of the different units ; secondly, comparative analysis of the varying activities, leading to standard practice ; and thirdly, the evolution of a process of decentralisation to give new elasticity.

Dr. Fenelon stressed the extent to which effective decentralisation depended not only on careful study

and preparation but also on getting the personnel to co-operate with one another and to think and act with enthusiasm. Centralisation of administration, that is, control of policies and centralisation of the management of each of the chief functions, did not always in practice go together. Improved management methods had greatly facilitated the centralisation of administrative control, and an economic research department or a statistical department frequently gave specialised assistance. The chief danger of administrative centralisation lies in pushing it to a point at which the initiative of local executives is destroyed and the organisation becomes unresponsive to variations in local conditions and the demands of local markets.

Administration and management, however, cannot be kept entirely distinct. It is essential to provide that a managerial staff shall be consulted in the formulation of policies, their active consent obtained and their interest aroused, and Dr. Fenelon referred to the advantages of the wise use of committees, and a budgetary system. With regard to the control of particular functions, the extent of centralisation or decentralisation should be determined by the nature of the function, and the relative importance of technical knowledge, personal contacts with customers, etc. Considering types of organisation, Dr. Fenelon referred to methods of co-ordination, through a system of committees, and to the use of staff on the lines advocated by Major Urwick. He suggested that in any industry there was a definite size of organisation beyond which smaller returns on capital and organisation were obtained. Moreover, success or failure was often determined by the willingness or otherwise of the chief executives to delegate authority and by the closeness of the attention given to the form of organisation and to the principles of administration.

Fourth Imperial Entomological Conference

THE fourth Imperial Entomological Conference, which was summoned on behalf of the Imperial Institute of Entomology and attended by twenty-seven delegates, each representing a different Dominion, Colony or other area of the British Empire, was held in London on September 19–27. The delegates were received by Sir Charles J. Howell Thomas, chairman of the Executive Council, and devoted the remainder of the first morning to the appointment of committees concerned with questions affecting the future policy and activities of the Imperial Institute of Entomology. Afterwards, four mornings or afternoons were devoted to meetings of committees and a final business meeting, and five to public meetings at which papers were read and discussed. Visits were paid to Rothamsted Experimental Station, the Forest Products Research Laboratory, Princes Risborough, the Parasite Laboratory of the Imperial Institute of Entomology at Farnham Royal, and the Stored Products Research Laboratory, Slough. At Farnham Royal, much interest was taken in a cinematograph film shown by Dr. K. R. S. Morris, illustrating work on the collection in central Europe and Sweden of parasites of pine sawflies (*Diprion*) for export to Canada.

By the courtesy of the president and council of the Royal Entomological Society of London, the public meetings of the Conference were held in the meeting room of the Society at 41 Queen's Gate; the delegates were also given every facility to use the Society's library.

The papers read and discussed were: locusts and grasshoppers, by Dr. B. P. Uvarov; termites, by Mr. F. P. Jepson; cotton-stainers and their control, by Mr. W. Allan; sheep blowflies, by Dr. G. D. Morison; the biological control of insect pests, by Dr. W. R. Thompson; pests of stored products, by Prof. J. W. Munro; the need for forest entomologists, with special reference to the pinhole borer problem, by Dr. R. C. Fisher; and plant viruses and their insect vectors, by Dr. K. M. Smith.

It is impossible here to give even an outline of the contents of all these papers, but mention may be made of two, selected as typical examples. That by Mr. Jepson attracted great interest, as it was realised that it dealt with problems on the practical aspects of which much work is required and relatively little has been done. Authorities on termites are few, and most of them are primarily interested in the systematic branch of the subject. Mr. Jepson opened by indicating the enormous damage caused by termites to crops, forest trees and all structures in which timber is employed in the tropics and subtropics, and estimated the annual losses as several millions of pounds sterling in the Empire alone. He then devoted the main part of his paper to a very valuable account of the methods found effective in his experience for the construction of buildings of various types in order to render them proof against invasion by soil-nesting termites, the principle underlying all of them being the insertion between the superstructure and the soil of a barrier of concrete that the insects cannot pass through or round. In his experience (and this was confirmed by speakers in the discussion that followed), Government engineers are usually not inclined to welcome advice on the construction of termite-proof buildings, and great damage to or destruction of valuable buildings constantly results. In addition to excluding subterranean termites, however, it is further necessary, in many countries, to guard against the establishment of drywood termites in the timber of buildings. As these gain admittance in the winged state, the only solution is to use timber that is naturally immune or has been rendered so by artificial treatment. Owing to the contamination of food by the fæcal pellets of these insects, which occurs when they infest roof-timbers, food-safes, etc., the varied protozoan and bacterial fauna of their intestines deserves further study. In Ceylon, it is usually in houses attacked by them that cases of sprue develop, and there is reason for suspecting that the contamination of human food by their solid excrement is in some manner associated with the causation of this disease.

As a result of this paper and the discussion that

followed, a Committee on Termites was appointed, and the Conference adopted consequent resolutions in which it emphasised the heavy losses caused by termites and the lack of knowledge on them, and recommended the accumulation of data on the financial losses to buildings, agriculture and the forest industry, the identity and habits of the species involved, and methods of control. It also recommended that this matter be taken up with the Governments concerned with the view of providing for a thorough investigation of the whole problem.

In contrast to the above, Dr. Uvarov's paper was a report of progress on a subject on which a large amount of co-ordinated study has been carried on for several years. The possibility of preventing outbreaks of locusts is based on the fact that the swarming phase is produced from the solitary one under certain peculiar combinations of external conditions that occur at times in definite and relatively restricted areas. Once it is produced, the swarms spread over immense regions, and the invasion develops in spite of all efforts to stem it. As a result of the extensive international organisation of which the Imperial Institute of Entomology is the centre, records of the movements and breeding of swarms over the infested area of Africa and south-western Asia are analysed, and from the data thus obtained field investigations are made to locate the centres in which the outbreaks arise, with the view of studying the ecological factors concerned in their commencement and the possibility of preventing it. It has thus been shown that the recent outbreak of the tropical migratory locust, which spread gradually over the greater part of Africa, originated in one or two restricted areas on the Middle Niger, and that the red locust similarly originated in a very few areas in Northern Rhodesia and Tanganyika Territory. Work on the desert locust has not progressed so far, but outbreak centres have been discovered on the coasts of the Sudan and of Baluchistan, and it is almost certain that none exists in the inner deserts of Africa. It will therefore be seen that the international investigations have provided a foundation for a preventive anti-locust policy, by which the outbreak centres can be kept under supervision and incipient outbreaks suppressed.

The discussion that followed afforded evidence that similar outbreak centres are characteristic of the principal injurious grasshoppers of North America and Australia.

Timber in the Box-Making and Coal-Mining Industries*

IN 1931, the Forestry Commissioners appointed an Inter-Departmental Committee to inquire into the possibility of making better use of the timber supplies of Great Britain. An interim report was submitted by this Committee in 1933, and recommended a series of detailed inquiries into the demand for timber for certain specific purposes. A first report dealt with the demand for timber for box and packing-case manufacture in Great Britain, whilst a second, now before us, deals with the demand for timber in coal-mining in England and Wales.

In the first report it was stated that there were two distinct sections of the industry, the box and packing-case makers on one hand, and the shook-using firms who merely assemble the component parts of the boxes already prepared, on the other.

So far as was observed, the timber used for shooks is invariably imported, and there was no evidence that home-grown timber could economically take its place either in character or quality. In the box and packing-case industry, home-grown timber, chiefly spruce and fir, is being extensively used in Scotland, and its suitability for many kinds of boxes is widely admitted in other areas, subject to various provisos. The Scottish firms are using it for mineral-water boxes and beer boxes, for the larger and heavier sizes of fish boxes, for soap boxes, for machinery cases, and cases for shipping rope and generally for any type of box in which light weight and a specially dressed appearance are not essential.

"The fact," says the report, "that, within the limits of the present enquiry, 20 per cent of the timber used by box making firms throughout Scotland, and over 40% of the timber used by those in Aberdeen, is home-grown, is emphatic evidence that home-grown timber could be used more largely than it is in other areas if adequate supplies were available in good condition, and if the cost of transport did not make the price prohibitive." Even in Scotland, a number of criticisms of home-grown timber were made. Perhaps the chief, which certainly restricts its use for the finer and lighter types of packing-cases, is the question of the excessive quantity and size of the knots. The presence or absence of knots in home-grown or any other timber is purely a question of good sylviculture, which, with properly grown and tended plantations, should right itself in the future.

With the interest of the State in afforestation schemes during the past fifteen years, and the creation of State plantations extending to more than 250,000 acres, and with another 100,000 acres of privately owned woods, it is obviously desirable that outlets should be found to absorb the increasing supplies of material which will become available.

In the report on the demand for timber in coal-mining, the report shows that the cost of mining timber annually consumed in Great Britain is about £6,000,000, and represents approximately a cost of 7*d*. on every ton of coal put on the market. Of this quantity, some 2¼ million loads were imported in 1934. It is said that an increase in the proportion supplied from native sources is possible immediately, and it can be substantially supplemented in the future from plantations at present immature.

The chief need is an effective scheme for marketing the home-grown supplies, and steps towards the attainment of this end have been taken in the formation of a Home-grown Timber Marketing Association under the chairmanship of Lord Clinton.

* Forestry Commission. Report on the Demand for Timber for Box and Packing-Case Manufacture in Great Britain. Pp. 47. (London: H.M. Stationery Office, 1934.) 9*d*. net.
Forestry Commission. Utilization Series, No. 2: Report on the Demand for Timber in Coal-Mining in England and Wales. Pp. vi+77. (London: H.M. Stationery Office, 1935.) 1*s*. 3*d*. net.

Educational Topics and Events

CAMBRIDGE.—Dr. J. A. Ryle has been appointed regius professor of physic in succession to Sir. W. Langdon Brown, who retired on September 30.

At Trinity College, H. Cary Gilson, N. M. V. Rothschild and H. W. Melville have been elected to fellowships.

At Pembroke College, Dr. G. B. B. M. Sutherland has been elected to a fellowship and appointed lecturer and director of studies in physical sciences.

GLASGOW.—The King has been pleased to approve the appointment of Dr. Edward Hindle to be regius professor of zoology in the University of Glasgow, in succession to Prof. John Graham Kerr, who has resigned.

OXFORD.—Prof. H. S. Jennings, professor of zoology and director of the zoological laboratories at Johns Hopkins University since 1910, has succeeded Dr. A. H. Compton of Chicago as George Eastman visiting professor and fellow of Balliol College. Prof. Jennings is an authority on the behaviour of lower organisms and on genetics.

Prof. G. H. Hardy of Cambridge has been elected an honorary fellow of New College, of which for many years he was a fellow.

Mr. B. V. Rollin (in physics) and Mr. G. J. Whitrow (in mathematics) have been elected to Harmsworth senior scholarships at Merton College.

Science News a Century Ago

H.M.S. *Beagle* Crosses the Pacific

UNDER the date October 20, 1835, Darwin records: "The survey of the Galapagos Archipelago being concluded, we steered towards Tahiti and commenced our long passage of 3,200 miles". He says that, during the voyage, "We passed through the Low or Dangerous Archipelago, and saw several of those most curious rings of coral land, just rising above the water's edge, which have been called Lagoon Islands. A long and brilliantly-white beach is capped by a margin of green vegetation; and the strip looking either way, rapidly narrows away in the distance, and sinks beneath the horizon. From the mast-head a wide expanse of smooth water can be seen within the ring. These low hollow coral islands bear no proportion to the vast ocean out of which they abruptly rise; and it seems wonderful, that such weak invaders are not overwhelmed by the all-powerful and never-tiring waves of that great sea, miscalled the Pacific."

The Horticultural Society

A MEETING of the Horticultural Society took place on October 20, 1835, in the rooms of the Society in Regent Street. "The tables which are usually covered with a gorgeous profusion of rare and beautiful shrubs and plants," said *The Times*, "presented an unexpected wintry meagreness of appearance. The Secretary explained that the severe frosts of the previous two nights had materially interfered with the intended display, the thermometers suspended against the walls of the Society's gardens at Chiswick had, on both nights, been as low as 27 of Fahrenheit. . . . There were a few exotic plants, principally from the gardens of Mr. Rolleson, of Tooting. . . . From the Society's gardens was a stove plant of the Orchideous tribe, which was deemed a great curiosity. It was a native of Surinam and was almost unknown in this country. The flower petals were of a dark colour, and the more closely examined, the more beautiful appeared their markings. They had an agreeable fragrance, somewhat partaking of the combined odours of the moss rose and the honeysuckle. . . . From a nobleman's grounds at Catterick, in Yorkshire, had been sent a plate of the veritable old English golden pippin, as a proof that the species was not, as generally supposed, extinct."

Sir James South and Christ's Hospital Boys

THOUGH among many of his contemporaries Sir James South (1785–1867) was perhaps as well known for his litigious character as for his astronomical work at Campden Hill, a kindly act of his was the subject of a letter from "Præceptor" in *The Times* of October 22, 1835. "On Tuesday last," the writer said, "Sir James South invited 50 of the scholars of Christ's Hospital, together with the masters and officials of the establishment, to view the comet at his observatory at Kensington. The evening proving unfavourable for the purpose, Sir James devoted the time to an explanation of his various instruments of observation . . . and afterwards set his youthful auditors to give each a practical proof of his attention to what he had heard, with the results of which he expressed himself very much pleased. He then treated them with a plentiful supper, and on their departure gave them another invitation, that they might not be disappointed of their view of the comet." A second visit was paid next day, the comet was seen and Sir James South in his drawing room delivered a lecture "on the methods by which individuals, however humble, may overcome the early difficulties that may obstruct their path in the attainment of scientific knowledge. . . ."

Lyell, Agassiz and Deshayes

IN the course of a long letter to Sedgwick, Lyell on October 25, 1835, said of Agassiz: "His knowledge of natural history surprises me the more I know of him, and he has that love of imparting it, and the power of doing it with clearness, which makes one feel one is getting on, and that one has caught his enthusiasm. I feel this also strongly when in company with Deshayes, who continues steadily to cultivate his own branch, and that under somewhat discouraging circumstances. . . . As it is my wish to propose the Wollaston medal this year to Deshayes, I wish you would have a talk with Agassiz when he is with you about the matter, for I believe there is no one in London who has seen so much of Deshayes, and knows so well his acquirements and the difficulties he has over-come as Agassiz. I am sure that if we could draw Deshayes over here, he would make a grand reform in our Museums, like Agassiz, and that he would discover rich mines of hidden treasure. . . ." G. P. Deshayes (1797–1875) at this time was teaching privately and devoting his leisure to zoological and conchological studies. From 1839 until 1842 he lived in Algeria. After his return he gave private courses on geology and palæontology and in 1869 was appointed to a chair in the Muséum d'Histoire Naturelle. The Wollaston Medal of the Geological Society of London was awarded to him in 1870.

Societies and Academies

BRUSSELS

Royal Academy of Sciences (*Bull. Classe Sci.*, 21, No. 7, July 1935). P. BURNIAT: A normal surface of bigenus one in linear space of four dimensions. O. ROZET: Surfaces of coincidence. O. ROZET: The canonical pencil of a surface. ST. GOLAB: The rectifiability of curves in centro-affine plane geometry. YVONNE DUPONT: Th. De Donder's thermodynamic synthesis applied to the transverse Nernst and Ettingshausen effects (3). Bridgman's relation is deduced without using the unnecessarily restricted hypothesis of previous papers. J. L. DESTOUCHES: Operatorial kinetics. B. ROSEN and M. DÉSIRANT: Researches on the molecular spectrum of selenium vapour (2). The paper discusses the $^1\Sigma \rightarrow {}^1\Sigma$ band system and its fluctuations and deduces the value 1·9 volts for the energy of dissociation of the Se_2 molecule. M. H. WUYTS and MISS A. LACOURT: A new synthesis of sulphur derivatives of indol. A sulphur derivative of indol was obtained by the action of hydrochloric acid in methyl alcohol on methylthiohydrazide. L. VERLAINE: The analytical character of perception in the macaque. Experimental methods and the precautions necessary in investigating the sense of perception in this monkey are discussed. R. VANDERWALLE: Contribution to the study of the mechanism of the action of heat in anti-smut disinfection of the seeds of cereals. A critical discussion of suggested explanations and a description of inoculation experiments with a micromanipulator.

Forthcoming Events

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

Sunday, October 20

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Mammals".*

Monday, October 21

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—M. Burton: "Bahamas Sponge Fishery".*

Tuesday, October 22

EUGENICS SOCIETY, at 5.15.—(in the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—H. Brewer: "Eutelegenesis—Objections and Criticisms Considered".*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Pol Gerard: "Comparative Histo-Physiology of the Vertebrate Nephron" (succeeding lectures on October 24 and 25).*

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Sir James Jeans.*

Wednesday, October 23

ROYAL SOCIETY OF MEDICINE (SECTION OF COMPARATIVE MEDICINE), at 5.—Prof. J. C. G. Ledingham: "The Comparative Study of Clinically Allied Viruses: some unsolved Problems of Edward Jenner" (Presidential Address).

Thursday, October 24

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. M. Kennedy: Inaugural Address.

HALLEY STEWART TRUST LECTURE, at 6.—(in the Memorial Hall, Farringdon Street, E.C.).—Sir William Bragg.*

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (TEES-SIDE BRANCH), at 7.30—(at the Cleveland Scientific and Technical Institution, Middlesbrough).—Address by P. A. R. Leith (chairman).

Chr. F. Christensen: "By Air and Sea to the Antarctic Whaling Grounds" (Cinematograph Film).

Friday, October 25

GEOPHYSICAL MEETING (ROYAL ASTRONOMICAL SOCIETY), at 4.30.—Discussion on "Geodesy in India" to be opened by Capt. G. Bomford. Speakers: Sir Gerald Lenox-Conyngham, G. H. Tipper and Dr. J. de Graaff Hunter.

KING'S COLLEGE, LONDON, at 5.30.—Dr. Paul Dienes: "Intuitionist Logic and the Foundations of Mathematics" (succeeding lectures on November 1 and 8).*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Colonel A. E. Davidson: Presidential Address.

INSTITUTION OF CHEMICAL ENGINEERS, at 6.30.—Sir Harold Hartley: "Our National Coal Resources" (Second Hinchley Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (SECTION OF EPIDEMIOLOGY AND STATE MEDICINE), at 8.15.—Surgeon-Capt. S. F. Dudley: "On the Biological Approach to the Study of Epidemiology" (Presidential Address).

Official Publications Received

Great Britain and Ireland

League of Nations: International Committee on Intellectual Co-operation. Report of the Committee on the Work of its Seventeenth Plenary Session. (C. 290. M. 154.) Pp. 63. (London: George Allen and Unwin, Ltd.) 2*s.* 6*d.*

The Royal Technical College, Glasgow. Calendar for the One Hundred and Fortieth Session, 1935-1936. Pp. 476+xxiv. (Glasgow: Royal Technical College.)

Education in 1934: Being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Cmd. 4968.) Pp. xiii+217. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

The British Science Guild. The Alexander Pedler Lecture, 1935: Antarctic Exploration Past and Present. By Commander L. C. Bernacchi. Delivered under the auspices of the Geographical Association in Manchester on 22nd March 1935. Pp. 20. (London: British Science Guild.) 1*s.*

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1934. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iv+85. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

London Shellac Research Bureau. Technical Paper No. 4: Fundamental Physical Properties of Lac. Part 2: Thermal Properties. By Dr. Lal C. Verman. Pp. 20. Technical Paper No. 5: Direct Liquid Extraction Process for Pure Lac Resin. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 32. (London: London Shellac Research Bureau.)

The Royal Society of Arts. Cantor Lectures: Modern Spectroscopy. A Series of Lectures given before the Royal Society of Arts, November and December 1934, by Prof. Herbert Dingle. Pp. 47. (London: Royal Society of Arts.) 2*s.* 6*d.*

Eton College Natural History Society. Annual Report, 1934-35. Pp. 38+5 plates. (Eton: Eton College.) 2*s.* 6*d.*

Philosophical Transactions of the Royal Society of London. A746: A Photographic Investigation of Flame Movements in Gaseous Explosions. 7: The Phenomenon of Spin in Detonation. By Prof. William A. Bone, Reginald P. Fraser and Dr. William H. Wheeler. Pp. 29-68+plates 2-12. (London: Harrison and Sons, Ltd.)

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Period ended 31st March 1935. Pp. ix+133+14 plates. (London: H.M. Stationery Office.) 3*s.* net.

Air Raid Precautions. Handbook No. 7: Anti-Gas Precautions for Merchant Shipping. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 41. (London: H.M. Stationery Office.) 3*d.* net.

The National Physical Laboratory. Collected Researches. Vol. 25, 1935: Metallurgy. Pp. v+432+68 plates. (London: H.M. Stationery Office.) 25*s.* net.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1935; with Appendices. Pp. 48. (London: H.M. Stationery Office.) 9*d.* net.

North British Association of Gas Managers. Half a Century of Combustion Research (The William Young Memorial Lecture, 1935.) By Prof. William A. Bone. Pp. 24. (St. Andrews: North British Association of Gas Managers.)

The British Academy. Presidential Address, July 1935. By J. W. Mackail. (From the *Proceedings of the British Academy*, Vol. 21.) Pp. 11. (London: Oxford University Press.) 1*s.* net.

International Tin Research and Development Council. Bulletin No. 2: Solder. Pp. 54. Technical Publication, Series A, No. 21: Examination of the Surface of Tinplate by an Optical Method. By W. E. Hoare and Dr. Bruce Chalmers. Pp. 8+1 plate. (London: International Tin Research and Development Council.) Free.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1625 (T. 3533): Pressure Distribution on Wings with Ailerons. By W. L. Cowley and G. A. McMillan. Pp. 73+20 plates. 3*s*. 6*d*. net. No. 1641 (T. 3570): Cooling of an Air-Jacketed Engine. By A. S. Hartshorn. Pp. 55+17 plates. 3*s*. 6*d*. net. No. 1658 (Strut. 183): Abstract—A New Surface Extensometer. By T. W. K. Clarke. Pp. 2. 2*d*. net. (London: H.M. Stationery Office.)

Final Report (July 1935) of the Furunculosis Committee appointed July 1929 by the Rt. Hon. William Adamson and the Rt. Hon. Noel Buxton. Pp. 67. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

University of London. School of Librarianship at University College: Session 1935–1936. Pp. ii+321–334+12. (London: University College.)

Ministry of Health. Housing: Summary of the Principal Provisions of the Housing Acts and Public Health Acts in relation to the maintenance of Dwelling-Houses in a reasonably Fit Condition for Human Habitation. (Revised.) Pp. 8. (London: H.M. Stationery Office.) 2*d*. net.

Birkbeck College (University of London). Calendar for the Year 1935–1936 (113th Session). Pp. 268. (London: Birkbeck College.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 20: Ordovician Submarine Disturbances in the Girvan District. By Dr. S. M. K. Henderson. Pp. 487–509+4 plates. 4*s*. 6*d*. Vol. 58, Part 2, No. 21: The Geology of St. Kilda. By Dr. A. M. Cockburn. Pp. 511–547+5 plates. 6*s*. 6*d*. Vol. 58, Part 2, No. 22: Further Observations on the Genus *Lyginorachis* Kidston. By Dr. Mary G. Calder. Pp. 549–559+2 plates. 2*s*. (Edinburgh: Robert Grant and Son, Ltd.: London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1656 (S. 209): Effect of Wing Setting on Water Performance of Seaplanes. By W. G. A. Perring. Pp. 8+3 plates. 9*d*. net. No. 1661 (Int. 125): Expanding Passages on Aircraft. By F. B. Bradfield. Pp. 5+1 plate. 6*d*. net. No. 1663 (Spin. 210): Air Density Effect in Spinning. By S. B. Gates and A. V. Stephens. Pp. 7+4 plates. 9*d*. net. (London: H.M. Stationery Office.)

Other Countries

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1934 to March 1935. Pp. ii+12. (Accra: Government Printer; London: Crown Agents for the Colonies.) 2*s*.

The Rubber Research Institute of Malaya. Annual Report, 1934. Pp. ii+175. (Kuala Lumpur: Rubber Research Institute.) 1 dollar.

Bergens Museums Årbok, 1935. Naturvidenskapelig rekke, Nr. 1: Om *Arenaria humifusa* Wg. og dens betydning for utforskningen av Skandinavias eldste florælement. Av Rolf Nordhagen. Pp. ii+183+11 plates. (Bergen: Bergens Museum.)

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