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The Ancient Monuments of England

POSSIBLY few of the public who visit our ruined castles, abbeys and other historic sites are conscious of the extent of their indebtedness for their æsthetic enjoyment or the satisfaction of their intellectual interest to the activities of the Office of Works in the exercise of the powers conferred upon it under the Ancient Monuments Acts. The Friday evening discourse on "The Ancient Monuments of England" delivered by Sir Charles Peers, the Inspector of Ancient Monuments, at the Royal Institution on January 27, served a double purpose by demonstrating the various forms of activity of the Office of Works in carrying out this branch of its duties, and in reminding his hearers why these duties should have come to be accepted as the responsibility of a government department functioning at the charge of the State.

The sense of national responsibility in the matter of the preservation of ancient monuments and buildings, which afford concrete evidence of the life and history of Britain in the past, has been a plant of slow growth. As Sir Charles Peers pointed out in opening his address, the term 'ancient monument' has been in use no more than fifty years; nor does it even now apply to every monument of antiquity. Until recent legislation, it covered only certain restricted classes of prehistoric remains; and it does not apply to any church, inhabited house, or to Crown property. Although Sir Charles did not dwell on this aspect of his subject, the dangers are patent.

Any building or structure which falls within these latter categories, whatever its historic interest or æsthetic value, is at the mercy of any craze for 'improvement' or restoration, however well- or ill-instructed, or even, in the instance of the private owner, of desire for pecuniary gain. In the not very remote past, priceless panellings and carvings in wood and stone have been torn from their settings and sent to America; and only a year or two ago the historic palace of Queen Elizabeth at Enfield was demolished, although a public-spirited purchaser was ready to forgo a handsome profit, had a public body been prepared to accept his offer to sell at a comparatively low price. An object-lesson of the enforced impotence of the Office of Works is afforded by the reply of Mr. W. J. Ormsby-Gore, as First Commissioner of Works, when asked recently in Parliament if his Department would not intervene to secure the

preservation of the historic buildings of the Adelphi on the Thames Embankment. Archaeologists who are more immediately concerned with the preservation for science of the material bearing on the period before written records, have shown repeatedly that they would welcome a greater measure of control over the exploitation of privately owned sites of archaeological interest.

It must be admitted that under recent legislation great advance has been made, especially in the field of prehistoric and early historic times. The recent additions to the list of scheduled 'monuments' mark a greatly extended range for the operation of the Acts. Individual acts of vandalism, it may be assumed, will always be with us; but public opinion may now, perhaps, be credited with being so far educated as to deprecate, and even to do its best to prevent, anything like the wholesale destruction which threatened the stone monuments of Dartmoor or the neglect which allowed a monument like Stonehenge to fall into a deplorable condition a generation ago. It is rather the less conspicuous and spectacular sites which call for 'protection'.

Sir Charles Peers spoke of the distinguishing marks which primitive man by the use of his hands has set on natural objects, marks which set him apart from all other living things. These are documents beyond price for the study of the early history of man. While, as Sir Charles said, the work of man can never be obliterated by natural forces, it is equally true that it can be defaced and destroyed by man himself. However meagre, scattered, or insignificant, such evidences of man's early progress should be preserved from the destructive activities of both ignorance and deliberate vandalism.

Speaking more particularly of prehistoric antiquities, this desire to preserve even the least vestige that has survived from the past arises from no spirit of mere antiquarianism. Those who for many years pressed for the enlargement of the powers conferred on public authority under the Ancient Monuments Acts had more in mind than preservation for its own sake. Their object, from the point of view of archaeological science, was immediately practical—the preservation of the data with which the archaeologist must work. If we are able to present a connected story of the past in Britain from the time of our later stone age, say, 2300–2000 B.C., as Sir Charles Peers said, even though we cannot lay claim to a civilisation comparable to the venerable culture of

Mesopotamia or ancient Egypt, it is due to the synthetic studies of those who by patient plotting of scattered details on distribution maps have elicited conclusions out of all proportion to the apparent significance of any one piece of evidence taken in isolation. Yet in many instances such evidence has survived by happy chance rather than of design.

As an example of what has been achieved, Sir Charles surveyed present archaeological theory of the early peopling of the British Isles by the megalithic peoples and the beaker-folk; and in another connexion he spoke of the results of the series of excavations which in recent years have been carried out on the hill-top camps in different parts of the country. He might also have referred to the enlargement of our knowledge of the mode of life of prehistoric peoples which has come from single sites where there was little to show the casual observer before investigation, such, for example, as the home of the flint-miners of Blackpatch in Sussex and, had Scotland come within his purview, the bronze age village at Skara Brae, explored with the co-operation of the Office of Works under the direction of Prof. V. Gordon Childe, the most remarkable and illuminating habitation site of that period north of the Alps.

In emphasising the evidential value of material, much of which may be comparatively unimpressive, and the need for its preservation, it must be remembered that there is another side to the question. We owe a duty to posterity. There are at least two reasons why we should hand on to our descendants these evidences of antiquity in a state of preservation at least not less secure than we have received them. On one hand, they are the possessions not of a day, but for all time. On the other hand, if there is one lesson to be learned from the progress in archaeological studies during the last ten or fifteen years, it is that both method and theory in archaeology are being developed with great rapidity. Hence it behoves us to preserve untouched at least a part of that material to serve the needs of a generation better instructed than our own. On more than one occasion recently, directors of excavations have recorded that they have left part of a site untouched for future investigators. This might well be made a condition of permission to excavate or of the co-operation of the Office of Works in the examination of a site.

In looking to the rights of future generations, it is inevitable that the question of repair and

restoration should arise—a question of considerable difficulty in which, however, no better guide could be sought than Sir Charles Peers himself. Happily for the prehistorian, this is a question of less complexity in dealing with a prehistoric monument than it is for those who have the charge of early historic or medieval buildings. Repair, in the view held by Sir Charles Peers, should be reduced to a minimum, and considered as auxiliary to archaeological investigation. As an illustration, he referred to the recent work carried out under the supervision of the Society of Antiquaries at Stonehenge where, after this monument had been presented to the nation in 1919, steps were taken to prevent the fall of unstable uprights, and much valuable information bearing on the methods employed by the builders of the monument was obtained. Under present legislation, the future of our prehistoric monuments should be secure. They need for the most part nothing more than that they should be left undisturbed, pending the time when their careful examination in the interests of scientific archaeology may be thought desirable.

The difficult question of repair and maintenance was more nearly germane to the latter part of Sir Charles's lecture, in which he dealt with the more representative monuments of the early historic periods, Roman, Saxon, Dane and Norman. Here the question is not one of sites but of buildings, and he showed his audience in some detail the work that has been carried out with the co-operation of the Office of Works on such historic monuments as the coast-fortress of Anderida, now Pevensey, Portchester Castle, Whitby, Rievaulx and Byland, where much has been learned of medieval life and technical achievement from what in some instances, before operations began, had been no more than grass-covered hillocks.

Enough has been said, it is hoped, to indicate why the preservation of ancient monuments should be regarded as a national duty under the supervision of a public department, as is the safe custody of written records. The latter, however, stand in a different category. They can be kept under conditions which ensure their safety, so far as that is humanly possible, and they are accessible to the public only under proper supervision. Ancient monuments, we may say in a large number of instances, cannot be kept under 'lock and key'. Further, they are open to the vicissitudes of the weather and other causes of decay; hence the

appeals to the purse of the public, when some building of historic interest and importance is in danger, as happens, unfortunately, all too frequently. The Ancient Monuments Acts may ensure the protection of a site or structure in a technical sense by including it in the schedules to the Acts. They cannot thereby make provision for its maintenance, and this may involve a heavy sum. The best protection for an ancient monument is a public which has been trained from school age to recognise and reverence with understanding the relics of its past; and the maintenance of a monument which is a national treasure should be a public charge.

Diamonds

The Genesis of the Diamond. By Alpheus F. Williams. Vol. 1. Pp. xv+352+vi+89 plates. Vol. 2. Pp. xii+353-636+iv+plates 90-221. (London: Ernest Benn, Ltd., 1932.) 84s. net.

THE author of this monumental work on the diamond has supreme claim to authority on the subject, having been connected with the diamond industry for more than thirty years, latterly as general manager of De Beers Consolidated Mines, Limited, and consulting engineer to the Jagersfontein and Koffyfontein mines, and in former years as assistant to his predecessor in that post, his father, Dr. Gardner F. Williams, whose book, "The Diamond Mines of South Africa", published in 1902, gave the first authentic account of the rise and development of the diamond mines of South Africa. The present book is not confined to its titular subject, but gives also a very readable account, fully illustrated, of the present-day practice of diamond mining and recovery, as adopted by the De Beers Company at Kimberley and elsewhere, as well as a chapter on the alluvial diggings in the diamond-bearing gravels of South Africa.

So long ago as 1899, Mr. Alpheus Williams had started to record data bearing on the origin of the kimberlite pipes (the 'blue ground') and fissures, and the nature and genesis of the kimberlite itself. He also commenced making a collection of diamonds, the natural uncut crystals, with the object of determining the conditions under which the diamond crystal grows. Those who, in 1929, had the privilege of seeing this collection, and that of the crystal-inclusions other than diamond in the kimberlite, as well as the wonderful series

of photographs showing the surface structure of diamond faces and the internal markings and enclosures, and photomicrographs of rock and crystal sections, will best appreciate the immense value of this unique private museum—for such it amounts to. All must rejoice that wishes, then so fervently expressed for publication of a book dealing with it, shall have come to fruition.

One of the most interesting and successful pictures in the book is one in colour of the collection of uncut diamonds, natural size. There are also coloured reproductions of the more important of the 500 photomicrographs of rock-sections, most of the actual sections having been one and a half inches in diameter, in order the better to display the complete structure. Very valuable also are the many large-size photographs exhibiting practically every variety of diamond twinning, including cyclical and polysynthetic twins, as well as the star shapes and other better-known types. There are also projection-growth and cavity-form photographs, and others illustrating the glide planes in diamond.

Mr. Williams's mature view is that the kimberlite magma was of very deep-seated origin, genetically related to the magma which produced the ultra-basic rocks; and that, after the solidification of these latter rocks, they were fractured and at the time of the rise of the kimberlite magma fragments of them were carried up and eventually became impounded in the kimberlite at the time of its solidification. As regards the shape of the pipes, filled with kimberlite, the statement that they are generally round or elliptical in section, and resemble circular vents, is incorrect, this only applying to the shape near the surface; at greater depths they become more and more simple fissures. Some very convincing diagrammatic sections are given of the Kimberley pipe at different depths. The pipes are shown not to be volcanic craters or necks in the ordinary sense of the terms, but simply enlargements of a single fissure or of a junction of two fissures. Mr. Williams has found no evidence in support of the view so often expressed that violent explosive action had occurred during the rise of the molten magma which is now found filling the pipes and fissures. The explosive action occurred when the fissure was formed, before the rise of the kimberlite magma. Probably, owing to more rapid cooling, the magma solidified first in the fissures, while the contents of the enlargements, the pipes, were still more or less plastic, so that very little inter-

mixture of lower and upper magmas could have occurred. Hence fissure kimberlite is generally of lower diamond content than pipe kimberlite.

The author further explains that crystallisation of carbon into diamond started on a limited scale in the very early stages of the solidification of the original magma into the plutonic rocks found now as cognate inclusions in kimberlite. That the carbon had already crystallised at this stage is proved by the fact that some of these cognate inclusions carry diamond. The condition most favourable for the crystallisation of the diamond would probably follow some process whereby the carbon content of the magma would be concentrated. This would occur in the first instance during the period of the crystallisation and formation of the peridotite and pyroxene rocks, and a further concentration would occur when the magma began to rise. The conditions for the crystallisation of carbon into diamond would therefore be more favourable in the magma left behind. It was in this residual magma, before its ascent in the fissures and pipes, that the crystallisation of diamond was greatest. This richer portion in turn rose and intermixed with semi-plastic magma already filling the pipe.

As to the genesis of the diamond itself, it is now generally accepted that the diamond was not crystallised *in situ*. The author shows that kimberlite is essentially a mica-olivine rock containing many transported crystals of olivine, enstatite, garnet, diopside, phlogopite, and so on, as well as clusters of these minerals, and as the diamond was one of the first minerals to crystallise it must therefore also be a transported mineral. The diamond has already been shown to have crystallised out of the original magma before eruption, and in some cases before the solidification of the peridotite and pyroxene rocks, for these rocks occasionally carry diamonds, as already mentioned. The bulk of the diamonds, however, must have crystallised out of the magma which remained after the formation of the peridotite and pyroxene rocks. At the same time, there crystallised magnetite, graphite, ilmenite, garnet, diopside, olivine, phlogopite, and zircon.

In spite of the numerous attempts to reproduce diamonds artificially, the author does not believe that anyone has yet imitated the process of Nature. Enormous sums of money have been expended in the quest, but grave doubts are felt as to the justification of claims that experiments, however costly, have resulted in the creation of diamonds.

Sir William Crookes in 1897 at the Royal Institution, and again in 1905 at Kimberley, expressed the view that the diamond problem was no longer insolvable, in view of the development of the electric furnace. Yet to-day, twenty-eight years later, we appear to be in the same position, with no practical advance effected. In 1924 Sir Charles Parsons said that he had been trying to make diamonds for twenty years, and had spent twenty thousand pounds on his experiments, but had come to the conclusion that nobody had ever made diamonds, the claims of Prof. Moissan and Sir William Crookes having been mistaken.

As regards the crystal form and structure of the diamond, there can no longer be any doubt that it belongs to the highest, holohedral, class 32 of the cubic system. The frequent suggestions for a lower class of the system ('hemihedrism') are really due to the fact that the diamond in habit assumes more 'forms' of the same system than any other crystallised substance, garnet most nearly approaching it in this respect. The different conditions under which the crystals have separated from the magma are probably responsible for this, the influence of surface tension in the liquid from which they separated being very pronounced. For the formation of a crystal face is dependent on two forces, the interatomic force striving to produce characteristic planes at right angles (normal) to the attractive force, and the force of surface tension counteracting this and striving to produce sphericity.

Temperature, fluidity, sizes of atoms, all are factors in determining the resultant of these opposing forces. The striving for sphericity, while at the same time the crystallographic laws are being obeyed, is clearly shown by the diamond, which so often takes its full 'form', that of the hexakis-octahedron, the 48-faced solid which is so nearly spherical. When this force is less effective, the tetrakis-octahedron is produced instead, hence the claims for hemihedrism. Fortunately, X-ray analysis has decided that the diamond is truly holohedral, a conclusion further confirmed by piezo-electric experiments at Cambridge by Dr. Wooster, with diamonds provided by the author. The whole of Mr. Williams's own work and investigations in so many directions are in agreement with this conclusion.

A most fascinating chapter, illustrated by exquisite photographs, follows on the growth of the diamond, which must be read to be appreciated. A pathetic statement occurs here, showing

how commercialism so often impedes instead of helping scientific work. It reads: "An interesting feature may appear on the face of a diamond worth ten thousand pounds, the only record of which will be the photograph, because once the diamond enters the trade it is lost for ever from a scientific point of view." Hence, the world of knowledge is deeply indebted to the author of this delightful and valuable book for having secured these photographic records at the one and only psychological moment possible in each case, on the passage of these gems, Nature's loveliest of all crystals, from the 'pulsator' and sorting room of De Beers at Kimberley to the diamond cutter's destructive workshop.

A. E. H. TUTTON.

Animal Myths

Animal Lore in English Literature. By Dr. P. Ansell Robin. Pp. ix+196+8 plates. (London: John Murray, 1932.) 10s. 6d. net.

THE author of this book so nicely adjusts the balance between weight of learning and popular interest that he charms the scholar and the arm-chair reader alike. The growth of legends and myths concerning animals is traced from the earliest European literature to the times in which science has destroyed belief in them, while leaving them to embroider literature.

The first sources of legends were oral, and many of these myths which appear in the early classics originated in Egypt or in south-west Asia. Oral tradition was supplemented by mythological and astronomical fancies, and animal symbolism became a feature of early civilisations.

Aristotle among the early writers was remarkable in that he used personal observation in dealing with the animal world, whereas later writers, up to the sixteenth century, culled their natural history from earlier records or tradition. The Alexandrian Christian writers used animals as emblems of ethical and religious truths, and such ideas spread over the whole intellectual tradition of literary nations, appearing in writings, architecture and heraldry. Collections of allegories, in which animals appear, were called bestiaries, and the wild imaginings were drawn from legends, classical sources and the Septuagint.

The use of such fables and allegories persisted all through the Middle Ages, although sometimes the appeal was worldly and unedifying rather than ethical. Dryden in the "Hind and the Panther"

used the beast allegory in writing of the Roman Catholic and English Churches.

Many legends centre round the mysteries of birth and death. The ancients believed in spontaneous generation for insects, eels and worms, even to the time of Isaac Newton. The young of a bear was supposed to be born a formless lump and licked into shape by the mother's tongue—hence our expression 'an unlicked cub'; the reviewer confesses to a former belief that this referred to a lack of corporal punishment. The barnacle goose was believed to originate from deal planks soaked in salt water, from which grew barnacles; these in turn dropped young geese into the sea, and these last swam away to the fens and inland waters; this belief appears in English literature from A.D. 750 until the seventeenth century. The story of the Phoenix is traced from Egypt and occurs in literature from Hesiod's days—Aristotle indeed ignores it, but Tacitus, Tertullian and the Alexandrian fathers all give versions of it. The dragon was a monster common to the literature and beliefs of the whole world from the earliest times.

The history of the unicorn is instructive. It appeared as a distinct animal in the Septuagint, through a mis-translation of the Hebrew word 'reem' as 'unicorn' (Revised Version 'wild ox'), though the context shows that the animal was two-horned. The legendary one-horned beast was adopted widely, and Greek stories of a fierce one-horned Indian ass were transferred to it. This beast being reported as notably gentle to the female in the mating season, the legend grew up that the unicorn could only be subdued by a virgin. About Pliny's time the rhinoceros became known in Europe, and the facts about it and the legends of the unicorn became mingled, so that the subjugation of the rhinoceros by a virgin is related by Isidore in the seventh century. When later still, the narwhal's tusks, spirally twisted, were found on the shores of northern latitudes, they were hailed as unicorn's horns; these were supposed to possess magic curative powers, and the powdered horn was sold by apothecaries for more than ten times its weight in gold.

The basilisk appears in the Septuagint as a serpent, and by Pliny's time was a fearsome beast. Later we find the Englishman Neckam writing that a cock nearing old age lays an egg which is hatched by a toad, and from it emerges a basilisk. Vincent of Beauvais, and Glanvie, on the authority of the Venerable Bede, add to the

beauty of the story by giving to the basilisk, thus hatched, the body of a cock and the tail of a serpent. By the fourteenth century we get the alternative name cockatrice, in Wycliff's Bible for example. This name probably came from the Latin 'crocodilus', through low Latin 'cocodrillus'.

Besides such legends, we have the interesting, if mistaken, beliefs in the power of the hyæna and the hare to change their sex, of the eagle to renew its youth, referred to by the Psalmist: in the super-devotion of the pelican, in the purposeful deafness of the adder.

What farmer of to-day would give credence to the statement that a collar made of the wood of the fig will subdue the wildest bull? Or that a stag draws forth snakes from their holes by the in-drawing of his breath? The goat and deer family were stated, even by the cautious Aristotle, to use the herb dittany to eject wounding arrows from their bodies, and Pliny's statement that the blood of a goat would split a diamond into pieces was accepted without question. Pliny, too, refers to the belief that goats were never free from fever, folk-lore which is interesting because of the recently established connexion between goats and relapsing fever.

These and many other stories are enlivened by collotype illustrations from early manuscripts, herbals, etc. Surely every naturalist must appreciate the appearance and habits of these beasts and must feel a faint envy of his predecessors' ability 'to get away' with stories, untrammelled by cold facts.

E. G. G.

Vitamins

Les vitamines. Par Mme. Lucie Randoïn et Henri Simonnet. (Collection Armand Colin: Section de biologie, No. 145.) Pp. iv+220. (Paris: Armand Colin, 1932.) 10.50 francs.

TWO distinguished French workers in the field of vitamin chemistry and physiology have attempted in this little book a task the difficulty of which can probably be appreciated to the full only by those who have attempted the same or a similar one. To take a living and growing subject, especially in the biological sciences, and attempt to expound it to the non-technical reader, is to run one of two risks. Either everything may be made artificially simple by the use of too facile generalisation, by the suppression of inconsistencies and difficulties, by presenting as accepted facts what are actually only the author's interpretations

of facts; or the saving clause and the citation of unexplained exceptions, the clumsy attempt to describe in words of one syllable what can only be defined neatly in words of many, the patronising parenthesis and the irritating footnote—all these may combine to scatter and confuse the reader. In the former case, technical colleagues look askance, and rightly: in the latter, non-technical readers turn away, and naturally.

Mme. Randoin and M. Simonnet have on the whole steered an admirably clear course between this Scylla and that Charybdis. If their treatment of the subject invites any serious criticism at all, it is for a little inconsistency of outlook as to the knowledge of their potential readers, and this is perhaps because they are physiologists rather than biochemists. Consequently they tend to indulge in undue detail of explanation when discussing the chemical aspects of vitamins and in undue use of medical phraseology when describing the clinical manifestations of deficiency diseases.

It is inherent in their subject that some of what the authors have written is already quite out of date, though their book was only published last year and they actually cite the results of research published in the middle of 1931—such as the

preparation of crystalline vitamin D products. In spite of this, the book should prove an invaluable guide to those who wish to learn or to relearn the outlines of a subject increasing in importance and in the recognition of its importance. To the technical reader perhaps the most interesting feature will be the light shed by the book on the French view of the vitamin B complex—a view to which its authors have so largely contributed by their own investigations. Their insistence, too, that vitamin C is concerned with iron metabolism will come as a new conception to most English readers. But it is surprising to find such careful and up-to-date workers advocating without qualification the use of purified butter-fat in a rachitogenic diet (p. 91), more especially since their observations on p. 84, that “la vitamine à doser puisse être séparée de tous les autres principes alimentaires, lesquels ne doivent pas en contenir la moindre trace” illustrates unequivocally an essential principle of biochemical methodology.

The book shares with many books published in France the defect of having no index, but its general production and format call for little criticism, especially in view of its extremely low price.

A. L. B.

Short Reviews

The Physics of High Pressure. By Prof. P. W. Bridgman. (International Text-Books of Exact Science.) Pp. vii+398+5 plates. (London: G. Bell and Sons, Ltd., 1931.) 22s. 6d. net.

PROF. BRIDGMAN has achieved an international reputation for his researches into the properties of matter under high pressures, so the volume under review is assured of a warm welcome by all who have studied the work which has been so assiduously pursued during the past twenty-five years. Prof. Bridgman is known personally to many on the eastern side of the Atlantic for in 1929 he gave the Guthrie lecture to the Physical Society.

Whilst the primary aim of the volume under review is to give a résumé of Prof. Bridgman's own work, the contributions of others are duly recorded. In the first chapter, which is of a historical character, will be found 12 pages of references to work on this subject antedating that of Prof. Bridgman's. The book constitutes a comprehensive handbook on the technique of physical measurements under enormous pressures; a technique which is highly specialised.

Although the subject at the present time is of purely scientific interest, the fact must not be overlooked that many chemical reactions are now being carried out under moderately high values of both pressure and temperature on an industrial

scale, so the experience gained in the laboratory will in due course find application in the field of technology. The theoretical side of the subject has not advanced much but the quantitative description of a large number of high pressure phenomena may be expected to have some ultimate theoretical significance.

Prof. Bridgman tells a story of absorbing interest, the fare he provides is both interesting and enduring and the book may be recommended to those whose appetite has become jaded through a surfeit of speculative physics. In this volume we are told how pressure affects the various physical properties of matter such as the electrical resistance, the thermo-electric property, viscosity, the thermal conductivity, etc.

E. G.

Fuel Testing: Laboratory Methods in Fuel Technology. By Godfrey W. Himus. Pp. x+257+5 plates. (London: Leonard Hill, Ltd., 1932.) 15s. net.

MR. HIMUS, lecturer in fuel technology at the Imperial College of Science and Technology, has made it his business to collect the latest available data regarding this most important subject and put it together in a volume which forms a veritable treatise. It is refreshing to find a book which deals specifically and clearly with a single subject, and carries it through from A to Z.

Naturally, due to his associations with Prof. W. A. Bone's laboratory, the work done at that institution has received first consideration, but Mr. Himus also describes methods adopted by various other official institutions and private investigators which have been proved in practice to be suitable for the purpose in view. He describes in considerable detail and with all desirable clearness the various stages in fuel analysis, and whenever he deviates from the original investigator's rules and regulations he always carefully gives his reasons for doing so, and they are generally good enough to be accepted by anybody.

New fuels are coming into use every day for new purposes, and Mr. Himus's book, compact as it is, provides a valuable guide. It is well indexed, well illustrated, well printed, and should be found in the reference library of everybody interested in the winning and using of fuel.

The Case Against Einstein. By Arthur Lynch. Pp. xxx+275. (London: Philip Allan and Co., Ltd., n.d.) 10s. 6d. net.

MANY thinkers, even among the "hierophantic display of the professors" who support Einstein, will be with Col. Lynch in some details of his enthusiastic criticism of the theory of relativity. The paradoxes of simultaneity, the variability of mass and the extraordinary properties of the space-time continuum, are stuffed with implications which need clarification. Einstein himself has said that his task is not yet completed. But it seems that Col. Lynch goes too far in asserting that the theory of relativity consists in giving to mathematical expressions strained meanings and in setting down as realities what are conventional modes of representing operations. In reading his book, one cannot make out whether it is addressed to the crowd, whom he despises, or to the learned, who share in his general impatience with all who disagree with him. In the first case, the author's plea would have been amusing if it was devoid of the specks of learning he places here and there. In the second case, Col. Lynch might have induced "the pundits" to give him a hearing, if he refrained from mixing his integrals with emotional remarks and irrelevant stories about himself and others. As it is presented, the book has, at times, an irritating flavour, where it could have been courageous and useful. T. G.

The Great Age of Discovery. Edited by A. P. Newton. Pp. xi+230+31 plates. (London: University of London Press, Ltd., 1932.) 15s. net.

THE chapters of this book consist of a series of lectures given by seven different authorities in King's College, London, designed to cover the great movements in discovery during its most fruitful age. It is not, however, merely a series of disconnected episodes, since each great voyager is regarded in his historical setting and the whole gives a coherent view of the development of the

map of the world during the late fifteenth and early sixteenth centuries. Each lecture is thoroughly documented with references to original sources and there are reproductions of old maps as well as other illustrations.

In his chapter on Columbus, Prof. Newton gives reasons for discarding the story about the Toscanelli letters, and is inclined to accept Vespucci's account of his second and third voyages and to suspend opinion on his first voyage. He believes that Tristan da Cunha and not South Georgia was the southern island that Vespucci claimed to have discovered in 1502. These are merely examples of the many problems that are reviewed throughout the volume.

Il polarografo: sua teoria e applicazioni. Per Giovanni Semerano. Pp. vii+207. (Padova: A. Draghi, 1932.) 16 lire.

THE polarograph is an apparatus devised by Prof. Heyrovský and Dr. Shikata at the Charles University, Prague, to register automatically current-voltage curves during the electrolysis of solutions, using a cathode of dropping mercury.

By the aid of this apparatus, Heyrovský and his collaborators have made a series of investigations on 'polarographic analysis'. The method has not only been used in studying the deposition of metals from solutions of their salts but has also found application in elucidating some minor problems in such widely separated fields as biology (lymph and cutaneous diseases), sugar and petroleum technology and pharmacology.

In his very informative Italian monograph, Dr. Semerano describes the apparatus and its uses in the determination of deposition potentials, etc. He discusses the significance of the current maxima observed in certain circumstances and also gives an account of the applications of the method. More than a hundred papers on polarographic researches are cited in the bibliography.

The Map of England: or About England with an Ordnance Map. By Col. Sir Charles Close. Pp. x+166+8 plates. (London: Peter Davies, Ltd., 1932.) 6s. net.

To all who use Ordnance maps in the field this book should prove most attractive and full of indications for further exploration of the countryside. Broadly speaking, it consists of three parts. First comes a historical sketch of the mapping of Great Britain and the origin and growth of the Ordnance Survey. Next comes instruction in the reading of a map, which should enable many users of the map to find much more in it than they knew was there; and lastly, there are several chapters on the archæology of maps as expressed in place names, ancient buildings, fortifications, etc. These chapters are exceptionally interesting. The book is illustrated with a few photographs and reproductions of maps and there are useful bibliographical references to each chapter.

Phenomenal Regression to the Real Object

By DR. ROBERT H. THOULESS, Department of Psychology, University of Glasgow

FECHNER'S law, that sensation intensity is proportional to the logarithm of the intensity of the stimulus divided by its absolute threshold value ($E = k \log(R/R_0)$) presupposes that there is a single sensation intensity for every stimulus strength. This is true not only of Fechner's law but also of any alternative law of the general form $E = f(R)$. Such invariable correspondence is only found, however, under artificially simplified conditions of perception. Under other conditions, it may break down at either of two points in the total process of perceiving: external stimulus → peripheral physiological process → central physiological process → phenomenon (that is, what is experienced).

A breakdown of correspondence between external stimulus and peripheral physiological process (that is, a condition in which a single intensity of stimulation does not provoke a single intensity of response in the sense organ) is to be found in the facts of contrast. In these, the intensity of the sense-organ's response is determined partly by the intensities of surrounding and of preceding stimuli. If, for example, two identical pieces of grey paper are seen against a white and a black background respectively, then the one on the white background seems the darker. That this is a change in the peripheral physiological process and not (as was once supposed) merely in the phenomenon, is shown by the fact that even in the after-sensation the difference persists; the after-sensation of the grey on the white background appears brighter than that of the other even when the after-sensations of the backgrounds are not themselves visible. Any assertion of a quantitative relationship between sensation and stimulus must, therefore, be stated for a definite condition of spatial and temporal background, since it is a theoretical possibility that a relationship determined for one condition of background may not hold for another.

Another set of conditions disturbing this relationship is universally present in ordinary everyday perceiving, although it may generally be eliminated from a laboratory experiment. Hering found that if a white paper was placed so much farther from a window than a grey paper that it reflected less light to the eye than the grey, it might nevertheless still appear brighter than the grey¹. Here the breakdown in correspondence between stimulus and sensation proves to be between the peripheral physiological process and the resulting phenomenon. It is found that the after-sensations are equally bright when the illumination of the two papers is adjusted so that they reflect equal intensities of light to the eye, although the appearance of the papers is then of unequal brightness. Since the after-sensation is itself purely determined by the nature of the peripheral physiological process, it follows that (unlike the case of contrast) equal external stimuli are now producing equal

retinal processes and the inequality of the resulting phenomena is introduced at a further stage of the perceptual process. Whether this is between the peripheral and the central physiological processes, or between the central processes and the resulting phenomena, there is, of course, no experimental method of finding out.

An extensive quantitative investigation of this tendency has been made by Katz², and Köhler has discovered that the reactions of hens and of chimpanzees show its effect³. The name originated by the German investigators—the tendency to *colour-constancy*—is, however, open to objection. Other experiments do not confirm the existence of any general law that phenomena tend to remain constant under varying stimulus conditions. The essential fact seems rather to be that the relative phenomenal brightness of two illuminated papers of different albedo is not determined solely by their relative luminosities (or the relative luminosities of their retinal images) but also by the 'real' or physical brightnesses of the papers (that is, their relative albedo). Phenomenal brightness is a compromise between stimulus brightness and 'real' brightness (albedo).

This principle is found to be widely true in visual perception, applying to the seen shapes of objects inclined at an angle to the observer, to the seen sizes of objects at different distances, to the degree of convergence of parallel-sided objects pointing from the observer, and to the colours of objects under different illuminations. A circle, for example, inclined at an angle to the observer is seen not as the ellipse which is its perspective projection (and also its retinal projection) but as a much wider ellipse which is a compromise between this stimulus shape and the real shape of the object⁴. Similarly, if two different sized objects are observed at different distances such that their apparent sizes are equal, this is not when they are making equal retinal images but when the retinal image of the actually smaller and nearer object is very much greater in size than that of the farther and larger object. Seen size is thus also a compromise between stimulus size and the real size of the object observed. These facts may be summarised as a tendency of phenomenal characters of objects visually perceived to regress from the characters given in peripheral stimulation towards the 'real' or physical characters of the object observed.

These effects can be much reduced or altogether eliminated by so simplifying the conditions of perception as to eliminate the perceptual cues to the real character of the object: by partially closing the eyes, completely closing one eye, or (still more effectively) by looking with one eye through a blackened tube cutting out surrounding objects. They return, however, when the ordinary method of perception is resumed. The results of

these observations may be summed up in the form of a law: *When a stimulus which by itself would give rise to a certain phenomenal character is presented together with perceptual cues which indicate the physical character of the object, the resulting phenomenal character is neither that indicated by the stimulus alone nor that indicated by these perceptual cues, but is a compromise between them.*

The tendency to phenomenal regression may be most simply demonstrated to a person unfamiliar with it in the following way. He observes an elliptical object such as an elliptical table top with its long axis pointing towards the axis of his body. With both eyes fully open, he then adjusts the height of his head until the apparent shape of the object is circular. Then, keeping his head in the same position, he determines the perspective shape of the object by the usual method of closing one eye and measuring the projected short and long diameters by means of a pencil held out at arm's length at right angles to the line of vision. He finds that this projected shape is a very much flattened ellipse. The circular shape seen is a

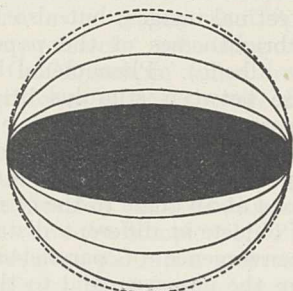


Fig. 1.—Phenomenal regression of inclined circle (median and extreme values for a group of 105 adult subjects).

compromise between the flattened ellipse of the retinal projection and the elongated ellipse which is the real shape of the object.

The testing of a large number of subjects (nearly two hundred) has shown that these effects are to be found in all⁵. In no case was the phenomenon experienced identical with the stimulus character but always a compromise between this and the real character of the observed object. The amount of this dependence on the real object showed very wide individual differences. The extent of these differences is shown in Fig. 1 for an experiment on the perception of an inclined circle. The black inner figure is the plane projection of the circle at the angle of inclination at which it was observed. The central continuous elliptical line shows the average seen shape for the whole group of subjects, while the other two continuous lines show the extreme values of the seen shape for the subject who saw it nearest to the stimulus shape and to the real (circular) shape respectively.

The intercorrelations of the amount of this tendency to phenomenal regression in the perception of size, of shape, and of whiteness show that it behaves as a unitary mental function; the subject who sees close to the real character in one of these respects will tend also to see close to the

real character in others. A large tendency to phenomenal regression amongst Eastern races may be an explanation of the absence of perspective and of shadows in Oriental art. The fact that a group of Indian students showed a significantly greater tendency to phenomenal regression than a control group of British students lends likelihood to this explanation.

In studying such facts as these, we are clearly outside that region of facts of sensory physiology for which alone Fechner's law has been stated. We are not, however, outside the region of legitimate quantitative experimental study, although we must not here expect to find simple quantitative laws of universal validity. The phenomenal fact which is not a fact of peripheral physiological process may reasonably be presumed to be a fact of central (cortical) physiology. Since, however, such cortical physiological processes are not at present open to direct study, these facts must be approached through a study of phenomena (that is, by the psychological method).

We may consider briefly a few of the practical applications of these principles. They have some bearing on the effectiveness of certain optical instruments. The usefulness of an astronomical telescope depends solely on its stimulus magnification. This, however, is not the case with a small pocket telescope bought, let us say, for looking at birds. The buyer wants the birds to look big so that they may seem near and lifelike. Mere peripheral magnification that does not attain this object is relatively ineffective. While a telescope magnifies the retinal image, it also diminishes phenomenal regression by introducing the condition of monocular observation through a blackened tube. The effect of phenomenal regression is apparently to make a distant object look larger and a near object look smaller. Elimination of phenomenal regression, therefore, reduces the apparent size of a far object, thus introducing a psychological factor antagonistic to the effect of magnification. So effective may this factor be, that, for a telescope of low power (as $\times 2$), there may be no appreciable apparent magnification in ordinary use, although there is obvious reduction of apparent size if one looks through the wrong end. With higher powers, phenomenal magnification falls considerably short of retinal magnification for the same reason. The ordinary user may, therefore, find more satisfaction in the use of binoculars of relatively low power, since their wider field of view and the presence of distance cues through retinal disparation causes less elimination of phenomenal regression and so fuller psychological advantage from the magnification of the retinal image.

Another practical application of this principle is to be found in the projection of pictures. It has been said that the present television apparatus cannot be expected to give much satisfaction to the observer since the image is far too small—about four inches square. I have, however, several times measured the angle subtended by a cinema

screen when at a distance at which the picture was quite as large as was necessary to appear life-like (to have gone much nearer would have made the screen look too big). Yet the side of the screen proved to be subtending an angle little more than half of that subtended by a square of four inch side if viewed from the ordinary distance for comfortable observation of ten inches. Obviously, therefore, it is not a defect of retinal size that makes the television picture ineffective. Phenomenal regression, which helps the distant cinema picture to look large, makes the near television picture look too small. The stray light in a cinema theatre which makes it possible to see the screen as a definite object at a definite distance, is serviceable to effective reproduction both by increasing

apparent size and by resisting the tendency to distortion for people sitting somewhat to one side of the screen. For the near television picture this definiteness of location is a disadvantage, and it may safely be guessed that the television picture would gain in effectiveness if it were viewed monocularly inside a box totally black inside, although a cinema picture would lose in effectiveness and apparent size by such a condition of viewing.

¹ Hering, E., "Grundzüge der Lehre vom Lichtsinn", 1905.

² Katz, D., "Die Erscheinungsweisen der Farben", Leipzig, 1911.

³ Köhler, W., "Aus der Anthropoidenstation auf Teneriffa" (2), *Abh. Kön. Preuss. Akad. Wiss., Phys.-Math.*, 1915.

⁴ Thouless, R. H., "Phenomenal Regression to the 'Real' Object" (1), *Brit. J. Psych.*, 1931.

⁵ Thouless, R. H., "Individual Differences in Phenomenal Regression", *Brit. J. Psych.*, 1932.

Raman Spectra and Chemistry

WHEN a transparent substance is illuminated, a small fraction of the light is always scattered at right angles to the direction of the beam without undergoing a change in frequency, a phenomenon which is known as 'Rayleigh scattering'. In 1928, Sir C. V. Raman, who at the time was investigating the scattering of light by liquids, actually photographed the spectrum of the scattered light for benzene and similar substances when illuminated with a beam of monochromatic light, and found a number of new lines of low intensity, in addition to scattered light of unchanged wave-length (which represented normal Rayleigh scattering by the liquid). These new lines in the spectrum differed in frequency from the monochromatic light used by amounts which were characteristic of the scattering liquid, but were independent of the actual frequency used to excite them. This phenomenon is known as the 'Raman effect', and the new lines are termed the Raman lines of the substance, which we now know may be either a solid, a liquid, or a gas.

The significance of Raman spectra in chemistry formed the subject of a discussion held by the Chemical Society on February 16, which was opened by Dr. J. J. Fox. The field is one which has expanded enormously since Raman's original investigations, and has yielded results of great value both to physics and to chemistry. In the present article the chemist's point of view has been stressed, both in describing the cause of the Raman effect, and also in reviewing some of its possible applications.

The origin of the Raman effect is well illustrated by regarding the light incident on the scattering medium as a 'photon' of energy $h\nu_1$, where h is the Planck constant, and ν_1 is the frequency of the light. This photon may be considered as interacting with a molecule of the scattering substance, and as losing a part of its energy. As a result, the scattered light will have a lower energy $h\nu_2$, and its spectrum will contain a new line of frequency ν_2 , which will be one of the Raman lines of the scattering substance. An

amount of energy $h(\nu_1 - \nu_2)$ must have gone to increase the energy of vibration or rotation of the molecule with which the photon collided. We know that this is what has happened, because of the close correspondence between the Raman frequency displacements ($\nu_1 - \nu_2$) and the rotational and vibrational frequencies of molecules, as deduced from infra-red absorption spectra. It is also possible for ν_2 to be greater than ν_1 , if the photon can absorb energy from the molecule instead of imparting it. This 'anti-Stokes' scattering is less frequent than the normal Raman effect.

It is important to distinguish between the Raman effect and fluorescence, which results from the absorption of light energy, followed by a re-emission of radiation of a lower frequency, characteristic of the absorbing substance. For the production of fluorescence the exciting frequency must be greater than a minimum threshold value, and the fluorescent radiation will be of a fixed frequency if this criterion is satisfied. Fluorescence is of relatively rare occurrence, and is perhaps best known for solutions of certain dyes: it is obtained with atoms or molecules, whereas the Raman effect is observed only with molecules.

The correspondence between Raman frequencies and infra-red absorption spectra is well illustrated in the case of hydrogen chloride, which has an infra-red absorption band with its centre at 3.46μ . Wood found that hydrogen chloride has a Raman line with a frequency displacement of 2886 cm.^{-1} (that is, 2886 wave numbers, this being a measure of the light frequency in terms of the number of waves per centimetre). This frequency corresponds with a wave displacement of 3.465μ , which is in exact agreement with the position of the centre of the infra-red absorption band. This result means that the Raman line in hydrogen chloride is due to the absorption of energy by the molecule, and its utilisation to increase the vibrational energy of the two atoms along the line joining them, without change in the rotational energy. Liquid hydrogen, on the other hand, shows Raman displacements of 354 cm.^{-1} and

588 cm^{-1} , and these two values agree closely with rotational frequencies of the hydrogen molecule, as deduced from the study of band spectra. In this case it is the rotational energy of the molecule which is increased. Non-polar molecules do not absorb light in the infra-red, but nevertheless, may show the Raman effect, which is of special use in such cases in calculating moments of inertia of the molecules and the distance between nuclei.

The Raman effect is generally investigated by using the mercury arc as a light source, one or more of the stronger lines being isolated by the use of light filters. The substance to be examined is then illuminated as intensely as possible, and the light scattered at right angles to the direction of illumination is examined with a large aperture spectrograph. The amount of scattered light is generally extremely small, and exposures of up to fifty hours are often needed to obtain satisfactory photographs of its spectrum. Numerous special types of apparatus have been devised, as, for example, in the examination of liquefied gases by McLennan, or in the study of single crystals. Many substances have been examined in solution, as the Raman spectra of solvent and solute will generally be superposed. Temperature changes have little effect, unless the molecular weight changes with the temperature, in which case it may be possible to observe lines characteristic of the simple and of the more complex molecules (for example, sulphur and sulphur trioxide). The effect of the physical state is also small in most cases, liquid water, ice, and water in the form of water of crystallisation, for example, showing almost the same Raman spectra.

From the large amount of experimental results already collected, it is possible to correlate certain definite Raman displacements with the existence of a particular vibrating group in a number of different molecules. Thus a Raman frequency of about 2900 cm^{-1} is observed (among other lines) for a large number of organic molecules such as CH_4 , CH_3OH , and C_6H_6 , and has been definitely associated with the vibration of a C—H linkage. Similarly, the C=O linkage is characterised by a Raman displacement of 1710 cm^{-1} in all ketones, and of 1730 cm^{-1} in esters, whilst a double bond between two carbon atoms always gives rise to a frequency of about 1600 cm^{-1} . These frequencies undergo small but definite variations according to the nature of the rest of the molecule. Dr. Fox illustrated this in the case of the benzene frequency of 1600 cm^{-1} , which undergoes a gradual decrease in the chlorine derivatives as the molecule becomes heavier, as shown below :

C_6H_6	$\text{C}_6\text{H}_5\text{Cl}$	$\text{C}_6\text{H}_4\text{Cl}_2$	$\text{C}_6\text{H}_3\text{Cl}_3$	$\text{C}_6\text{H}_2\text{Cl}_4$	C_6HCl_5	C_6Cl_6	.
1584	1580	1572	1560	1558	1553	1510	cm^{-1}

This frequency has been attributed by Andrews¹ to the stretching of double bonds in the Kekulé benzene model. The Raman frequency will, in general, be between 2600 cm^{-1} and 4000 cm^{-1} if the vibrating pair is of the type X—H, less than

1200 cm^{-1} for X—X, 1200—1800 cm^{-1} for X=X, and 1800—2600 cm^{-1} for X \equiv X. These facts enable us to decide the structure of gaseous carbon monoxide, which has a Raman shift of 2155 cm^{-1} , indicating a triple bond, and not a double bond of the ketone or ester type. A recent communication to NATURE directed attention to the Raman spectrum of nickel carbonyl, in which the triple bond frequency for the carbon—oxygen linkage was shown to persist.² Organic nitriles (R.C \equiv N) and isonitriles (of the type RN \equiv C) show Raman displacements of about 2250 cm^{-1} and 2160 cm^{-1} respectively, but hydrocyanic acid shows two frequencies at 2062 cm^{-1} and 2094 cm^{-1} , the first of which may be attributed to a molecule HN \equiv C and the second to the tautomeric form HC \equiv N. The Raman spectrum of acetoacetic ester shows even more clearly the existence of the two tautomeric forms, since the ketone and the ester C=O frequencies (indicating

$$\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{C}\cdot\text{CH}_2\cdot\text{COOC}_2\text{H}_5 \end{array}$$
 the formula $\text{CH}_3\text{C}\cdot\text{CH}_2\cdot\text{COOC}_2\text{H}_5$), and also the C=C and the OH frequencies (indicating a

$$\begin{array}{c} \text{OH} \\ | \\ \text{CH}_3\text{C}=\text{CH}\cdot\text{COOC}_2\text{H}_5 \end{array}$$
 formula $\text{CH}_3\text{C}=\text{CH}\cdot\text{COOC}_2\text{H}_5$) are observed.

An interesting study of the ionisation of nitric acid has been made by Rao.³ At a concentration of more than 65 per cent, the acid shows a Raman line at about 1300 cm^{-1} , due to the NO_2 group, which is also observed in nitrites, nitrobenzene, nitromethane, and similar compounds. Only on dilution is the line at 1050 cm^{-1} , which is characteristic of the NO_3 ion in solutions or in crystalline nitrates, observed. This would indicate that the strong acid has the formula NO_2OH , a fact which harmonises with its nitrating action on organic compounds. Rao has claimed that the intensity of the line due to the NO_3 ion may be used as an approximate measure of the degree of ionisation of the acid. A similar phenomenon is observed with sulphuric acid. The acid of strength above 25 per cent shows a line at 1046 cm^{-1} , which is attributed to the (HSO_4) ion, since it appears prominently in solutions of potassium hydrogen sulphate (KHSO_4). At concentrations less than 25 per cent, a Raman line due to the $(\text{SO}_4)''$ ion makes its appearance. It is observed in solutions of sulphates, irrespective of the cation, and also in crystalline sulphates.

Dadiou and Kohlrausch have used the vibrational Raman frequencies, which may, in many cases, be associated with interatomic linkages in molecules, as a means of calculating the strength of binding of the two atoms. By treating the vibrating pair as a simple harmonic oscillator, it is possible to calculate the restoring force per unit displacement. The amplitude of the oscillation may also be derived, the product of these two quantities measuring the binding force. As calculated by this method, the strength of single, double, and triple chemical bonds are in the ratio 1 : 2 : 3. It is possible to calculate absolute

values of the strength of linkage from the relative values, if some one absolute value is known (for example, for the C—H linkage in the benzene ring, a value of 101,000 cal. per gram molecule may be used).

The discovery of the Raman effect is so recent that it is not surprising to find that theory has lagged behind experiment. Raman spectra may often be photographed with relative ease, but up to the present, the results have only been interpreted fully in the case of some of the simpler molecules, of which carbon tetrachloride may be taken as an example. Very careful examination of the Raman effect for substances of this type, and particularly, intensity and polarisation measure-

ments for the individual Raman lines, makes it possible to determine all of the fundamental vibrations in the molecule. This problem becomes more and more difficult as the molecule increases in complexity, but there can be little doubt that, in time, the subject will develop to a point where the chemist will be able to consider the molecule as a dynamic rather than a static system. In the meantime, we may anticipate that the accumulation of Raman spectrum data will continue, and that they will be applied to solve many problems of molecular constitution.

¹ *Phys. Rev.*, **36**, 537; 1930.

² *NATURE*, **130**, 1002, Dec. 31, 1932.

³ *Proc. Roy. Soc., A*, **127**, 279; 1930.

Obituary

PROF. PAOLO ENRIQUES

PAOLO ENRIQUES, who died on December 26, had held the chair of zoology and comparative anatomy at the University of Padua since 1921, and was the leader of Italian zoologists along the lines of genetic, physiological, and philosophical research. Born at Leghorn on August 17, 1878, he pursued his university studies at Florence, Rome, and Bologna, devoting four years to medicine, in which he qualified at Göttingen, and two to natural science, in which he took the doctor's degree at Bologna in 1901. In the following years he lectured at Florence on the philosophical approach to biology, at Sassari in medicine and later on comparative anatomy. While professor at Padua he also taught under the Faculty of Medicine in the Schools of Pharmacy and of Social Science, and for some years lectured on genetics applied to the breeding of silkworms at the Silkworm Station of Brusegana.

Besides a number of papers on various organs of Mollusca in their functional aspect, on reproduction in Protozoa, on the nucleus of Radiolaria, and similar subjects, Prof. Enriques published several works of wider scope. That which shows most clearly his critical and constructive thought is "La Teoria Cellulare" (Bologna, 1911), in which he attempted a synthesis of modern biological problems. In "Eredita nell' uomo" (1922) he brought to bear on the subject his medical knowledge of pathological characters, while in "Riproduzione dei Protozoi" (1922) he resumed the researches of himself and his pupils, which led to conclusions of fundamental importance, particularly regarding the biological cycle of the Infusoria. His "Trattato di Zoologia e di Anatomia Comparata" has been adopted in many Italian and some foreign universities. In a monograph on Mendel's laws and chromosomes, Enriques summarised the researches of the previous fifty years, and deduced from them new laws, adding to the three classic laws of Mendel a fourth law of independent variability based on his study of variability in radiolarian species, as well as various synthetic statements of the phenomena associated with sex and sex-linked characters. In 1928 he communicated to the Istituto Veneto his "Teoria

della Ciclogenesi", in which the difference between plants and animals was set on a new basis.

In a recent series of six "Contributi alla Teoria dell' Evoluzione" Enriques urged that heredity and evolution are not irreconcilable facts but that the phenomena are explicable by his fourth law of heredity. Not many months ago there appeared the three volumes of *Atti* of the eleventh International Congress of Zoology, to editing which he had devoted all his energies; they contain 1,500 pages and 38 plates. Herein are published summaries of some of his previous studies, as well as a proposed classification of Radiolaria. This last anticipates the classification to be followed in his monograph on the Radiolaria of the Gulf of Naples, a great work unfortunately left incomplete. Other books now in press are a translation of "The Biological Basis of Human Nature" by Jennings, and "Il problema della Vita" which purports to give in intelligible language a synthetic review of all the problems of biology considered in their manifold aspects—physical, chemical, morphological, and philosophical.

The value of Enriques' work was widely recognised: he presided over both the Unione Zoologica Italiana and the Accademia Scientifica Veneto-Trentino-Istria from 1928 until 1930; he was honorary vice-president of the International Congress of Genetics at Ithaca, United States, and president of the International Zoological Congress at Padua in 1930. There one saw the magnificent Institute of Zoology that had just been completed under his direction, and there the representative of Great Britain had abundant opportunities of appreciating his powers of oratory, his clarity of exposition, his originality of thought, and, beyond these, his friendly hospitality, his goodness of heart, and his devotion to the highest ideals of science.

The academic term was over; Enriques had started in his motor-car for Naples to continue his researches on Radiolaria; he was alone on the road that led across the Campagna, when an accident overturned his car; he was picked up and taken back to Rome, where he lay in hospital for a week; his recovery was looked for, but on Christmas Day, meningitis supervened, and he died on December 26. Thus all too early have Italy

and the world lost one who, to adapt his own words, exhibited "un temperamento passionale che si affigge in una idea grande e la persegue con ricerche e scoperte, o grandi o piccole secondo le sue forze, ma sempre avendo dinanzi la spiegazione generale e profonda della natura". F. A. B.

SIR DANIEL MORRIS, K.C.M.G.

THE death of Sir Daniel Morris, in his eighty-ninth year, brings to a close a long life devoted to the public service; but it is his work for the Empire, as Imperial Commissioner of Agriculture in the West Indies, that will be kept especially in grateful remembrance.

Except for the twelve years (1886-1898), when he was assistant director at Kew, under Sir William Thiselton-Dyer, Morris's work and interests had lain overseas in the Colonies, and while he held the assistant-directorship he was seconded to undertake a special mission to the West Indies (1890-91), in connexion with the development of the fibre, sugar and banana industries in particular; again, in 1895, he visited the Bahamas and the following year he was appointed expert adviser to the commissioners on agricultural and botanical questions, when the West Indian Royal Commission was sent out during Mr. Chamberlain's fruitful time at the Colonial Office. His valuable services were very fittingly recognised by his appointment as Imperial Commissioner of Agriculture in 1898. During the ten years he occupied this important post, he enlisted the services of a staff of experts to teach and advise in the Leeward and Windward Islands, and was able to bring about co-operation between the various islands and develop their agricultural industries on sound lines.

Among other valuable undertakings Morris's personal introduction of Sea Island cotton to the Islands was a signal achievement; to him also is due the improvement of the sugar cane by hybridisation, and the extension of the cultivation of limes and *Cacao* and other tropical products. The inter-colonial agricultural conferences which he established have done much good work, mainly in bringing together the agricultural officers and planters in the Islands and so helping to co-ordinate and stimulate their efforts.

Morris received the honour of the C.M.G., in 1893 "in recognition of Scientific and Economic Services rendered to Her Majesty's Colonies", and in 1903 he was advanced to K.C.M.G.

Before Morris went to Kew in 1886, he spent two years in Ceylon (1877-79), working on the coffee disease as assistant to Dr. Thwaites, and from there he was promoted to be director of Public Gardens and Plantations, Jamaica, a post he held for seven years. While holding this post he visited British Honduras, in 1882, and St. Helena in 1883. His report on the economic possibilities of St. Helena is a valuable document which, had it been followed up in practice, would have been of great benefit to the island.

While at Kew, Morris was treasurer of the Royal Horticultural Society from 1888 until 1891, and took an active part in the affairs of the Society at a critical time. He was enrolled a Victoria medallist of the Society and for many years was one of the vice-presidents.

Since his retirement Sir Daniel Morris was, until his health began to fail, an active member of the governing bodies of the Imperial Institutes of Entomology and Mycology, and of the John Innes Horticultural Institution. In Bournemouth, where he settled on his return home from the West Indies, he quickly entered into the scientific life of the community, and the present flourishing condition of the Bournemouth Natural Science Society is largely due to his keen and stimulating interest.

Morris's published papers deal mainly with botanical or agricultural matters of economic importance and are valuable works of reference. Very possibly much of the good work he was able to carry out was due to his skill as a speaker, for he was a lecturer as well as a writer of unusual ability. Lady Morris, who was his able ally for more than fifty-two years, died in January of last year.

DR. JOHN R. FREEMAN

FROM *Earthquake Notes* for December 1932, issued by the Eastern Section of the Seismological Society of America, we learn of the death of Dr. John R. Freeman on October 6, 1932.

Dr. Freeman was consulting engineer to several important engineering concerns in the United States. He was president of the American Society of Mechanical Engineers in 1904 and of the Society of Civil Engineers in 1921. He did much work in connexion with water engineering and fire protection. Dr. Freeman studied earthquakes from the engineer's point of view. His principal works are his detailed study of the Melfi (Italy) earthquake of July 23, 1930, and his great book on "Earthquake Damage and Earthquake Insurance", published last year, in which he made valuable contributions to the problem of earthquake insurance in the United States.

WE regret to announce the following deaths:

Prof. T. Alexander, formerly professor of engineering at Trinity College, Dublin, on February 17, aged eighty-five years.

Lord Lovat, K.T., G.C.V.O., K.C.M.G., formerly chairman of the Forestry Commission, who has done much work in connexion with the development of forestry throughout the British Empire, on February 18, aged sixty-one years.

Dr. A. D. Risteen, director of technical research in the Travelers Insurance Co., known for his work on industrial technology and safety, on December 30, aged sixty-six years.

Dr. John Watts, of the old Chemistry Department of the University of Oxford, author of memoirs on the industrial uses of tannins, on February 9, aged eighty-nine years.

News and Views

Christ's Hospital and Samuel Pepys

REFERENCE was made in the article on Pepys in NATURE of February 18 to his association with the Royal Mathematical School of Christ's Hospital, and the circumstances attending the foundation of the School are worth recalling. The project for a naval seminary, communicated to Charles II for his approval, was backed, in the first instance, by Sir Robert Clayton, Sir Jonas Moore, and Sir Christopher Wren; afterwards they were materially assisted by Pepys. Sir Jonas Moore was Surveyor General of the Ordnance and he solicited the favour of the Duke of York, then Lord High Admiral. A royal charter was granted and the School was opened in 1673 for forty boys. Little was done, however, by King Charles towards its maintenance, and the foundation suffered many vicissitudes. Pepys offered various objections from time to time to what he deemed inefficient methods of administration and teaching, and when, in 1698, he was appointed vice-president, he turned his attention to the re-modelling of the Mathematical School. The following is an extract from a letter of Pepys to the governors, dated May 4, 1694:—" . . . when, in the yeare 1676 a shipp of the King's (with another of certain private adventurers) design'd upon an Expedition for Discovery of a passage by the N.E. to China; wherein his then majesty had reason to expect many unusual occurrences, and therefore fit for a Child of this Foundation to share in the first advantage of: He was pleased to communicate his pleasure in it to the Hospital. In which, provision was made for the child's being not only well instructed in his service during the voyage . . . but returned at the end of it; as he accordingly was, and by us afterwards bound apprentice to a Merchant Man, Bartholomew Clement, Master of the Ffortune, tradeing to Virginia". In April 1699, Pepys was presented with the freedom of the City of London "in acknowledgment of the great zeal and concern for the interest of Christ's Hospital which he hath manifested on all occasions".

The Marquis of Worcester at Vauxhall

AMONG those pioneers of the use of steam for pumping who have found a place in engineering history is Edward Somerset, second Marquis of Worcester (1601-67), whose life was written in 1865 by the civil engineer, Henry Dircks (1806-73). The Marquis lived in troubled times but all his life was interested in mechanics, and in 1663 published his "Century of Inventions", containing notes in vague and mysterious language on inventions to be tried and perfected. Quite early in life, with the German master mechanic, Caspar Kalthoff, he became connected with the Ordnance Factory founded by Charles I at Vauxhall and on this site later in life he proposed to found a college for training artisans, and erected his famous 'water commanding engine', which attracted considerable attention. The interest surrounding the projects and achievements of the Marquis led Mr. W. H. Thorpe to attempt to deter-

mine the exact site of the works at Vauxhall, and in a paper read to the Newwomen Society on February 15, he gave an account of his researches and their results. The position of the property was, he said, indicated by a petition dated 1666 presented to Charles II by the Marquis, and the details of the property are described in a report made by the Surveyor General to the Duchy of Cornwall. Further evidence was obtained from Rocque's large-scale "Survey of London" made in 1739-45. For a description of the apparatus for pumping erected at Vauxhall, we are indebted to two foreigners who saw it, but neither of them refers to the use of steam. One of the notes in the "Century", however, refers to "an admirable and most forcible way to drive up water by fire", and it is this that gives the Marquis of Worcester his place among pioneers of the steam engine.

Industry and Electrical Research

THE twelfth annual report of the British Electrical and Allied Industries Association (E.R.A.) presented at the annual luncheon on February 15 is satisfactory and interesting. A period of depression in commerce often means greater activity in development. The report shows that there are seventy-seven committees actively engaged in advising and directing research on problems of urgent importance to industry. An incidental advantage is the benefit that accrues to individuals who share in the constant exchange of views which takes place at these specialist committee meetings. At the start, the organisation was almost entirely based on the sections of the industry connected with manufacturing. Its activities have now widened very much and there are very few electro-technical problems outside its sphere. The Association was never designed to relieve manufacturing works of the necessity of solving their own specific problems. The report proves that many of the subjects considered interest several branches of the industry. The financial statement shows that the main contributions, so far as money is concerned, now come from the electric supply companies, railway groups, etc. Although the actual income for last year was greater than the preceding year, yet the Association has adopted a conservative policy, maintaining its organisation intact, expediting the completion of researches and advancing the plans for new work. Many members of the permanent staff have been engaged solely in scientific investigations and the reports they have published have been useful to the industry.

MATERIAL progress has been made during the year towards ascertaining the real properties of dielectrics, as distinct from empirical measurements of their behaviour under given conditions. Numerous commercial problems are under investigation, as, for example, the study of radio condensers in co-operation with the British Broadcasting Corporation. Improved efficiencies in steam generating plant have been

effected mainly by a better knowledge of the properties of steam and studies on the creep of metals. Important conclusions have been arrived at by researches on wind pressure on overhead lines, heating of buried cables and cables in ducts, the armouring of cables and methods of efficient earthing. The work done on the design and use of concrete poles may lead the Electricity Commissioners to reconsider the present stringent regulations relating to their use. Important advances have been made in new types of switches to break large currents at high voltages. We are now abreast of the work done in competing countries and in some directions we are in advance. Thanks to experimental research and advanced mathematical calculations, the problem of the interference caused by power circuits on communication circuits can now be regarded as solved. Good progress has been made in the study of problems of importance in railway engineering. The printed schedule of headings under which the railway researches are being conducted now runs to twenty pages.

Training the University Graduate

IN the annual report presented by the Vice-Chancellor, Sir Charles Grant Robertson, to the court of governors of the University of Birmingham on February 23 comment is made on the increase in the number of students in spite of the general depression. It is pointed out that on the Continent, the universities are greatly congested, the attendances being, paradoxically, greater the greater the depression. The chief increase is in the faculty of medicine. The Vice-Chancellor raises the question whether the universities are doing all that they might or ought to do to meet the requirements of the rapidly changing social conditions. For example: "if the Universities are providing, and will have to provide to an increasing extent, direct training for careers, not contemplated twenty years ago, and those careers require a special technique, the essential problem is as to whether that technique can be taught, or whether the true function of the University lies in preparing for the most rapid acquisition of the technique elsewhere and as a post-graduate business. 'Technocracy' is the latest American gift, and we may fear the United States—especially as a giver—but do we not need as a nation, *outside* the Universities but definitely correlated to them, a series of 'schools' which will do for the University graduate, who has not been like the engineer technologically trained, what the Hospital does for the medical graduate who becomes, for a strictly limited period, a House Physician and a House Surgeon? Do we not also need a much closer connexion between the big Technical Colleges and Schools and the Universities?" In referring to the report of the Joint Standing Committee on Research, the Vice-Chancellor gives his opinion that "the Committee ought to be in a position to support a plan of research conducted by a Department as a whole on definite lines and for a definite purpose and extending over a defined period". The only obstacle to such a policy is of course the financial one.

Specialist Posts in Industrial Management

AN article by Dr. W. H. Coates in the January number of the *Journal of Careers* reviews the developments in industry which have led to the creation of specialised posts in industrial management. These developments are the outcome of the changed conditions of industry and the heavier demands upon human qualities in management which are made by the growth of the scale of industrial enterprise and organisation. Where formerly several men filled one function in several small businesses, there are now several men each specialising in one function in large-scale business. These specialised activities can be broadly classified as they are concerned with production, sales or administration. We thus have the new key positions such as planning and production manager, transport manager, sales manager, secretary, personnel manager, labour officer, purchasing officer, etc. Specialisation in this way, concentration of research, thought, and practice within a limited field, is steadily leading to more efficient management, to fuller knowledge and to new ideas, and affords also a way of applying the scientific method to an increasing extent to the problems of administrative and executive control. Dr. Coates visualises alike a large field in which scientific methods have to be applied with an accuracy, patience and persistence comparable with those applied in the fields of physical science, and a field of human co-operation which makes large demands upon team work if the problems of large-scale industrial management are to be solved. Given such conditions, Dr. Coates sees no limits to successful management implicit in the size of the undertaking, and is confident that there is no lack of young men who are capable of tackling the present and future problems of large-scale management.

Fat in Aestivating Animals

IT is a matter of common knowledge that many hibernating animals, in cold climates, survive their long and enforced fast by accumulating fat within the body, or immediately under the skin. It is by no means so generally realised that a precisely similar accumulation is made by many animals living in hot climates, which must also fast, in a state of aestivation, until food is again procurable. A good opportunity of making observations on some aestivating types has just been furnished by the birth at the Gardens of the Zoological Society of London of four 'fat-sand-mice' (*Steatomys*) and four 'fat-tailed gerbils' (*Pachyurus*). For this curious adjustment has now apparently become fixed, since even in captivity the fat is still stored, though its need has disappeared. But there seem to be no records as to whether the amount of fat formed is less in captive animals, which have no need to fast, and at what stage in the growth of the young animal it begins to make its appearance. There seem to be no possible means of discovering why, in these two types, living under precisely similar conditions, one should form a deposit of fat over the greater part of the body, while in the other it should accumulate in the lower part of the back and tail.

Candles and Candlemaking

THE science and art of illumination are nothing if not progressive and the displacement of the candle, emblem of humble domesticity and spiritual occasions, by other forms of light is but one of the inevitable consequences of modern progress. Candle manufacture is casually regarded as a minor industry to-day, but such is actually not the fact as Mr. David Allan showed in his paper on this subject before the Institution of Petroleum Technologists on February 14. The candle has had a firm place in history and religion since ancient times. Its simplicity of construction and self-contained character have commended it for use in diverse circumstances where soft and easy illumination have been required. Essentially a cylinder of fat or wax enveloping a fibrous core or wick, cast in various shapes and sizes, its form has varied but little throughout the ages. Attention latterly has been paid chiefly to efficiency and cheapening of methods of manufacture, while a measure of artistic evolution is discernible in the shapeliness of form and decorative effects achieved in the modern product. The candle industry, in so far as it relates to manufacturing process, is a comparatively straightforward matter, but the technology behind it is by no means so simple. The author has done good service, not only by presenting a comprehensive account of the subject, but also in describing the essential technology. While the petroleum industry cannot claim the candle as entirely its own product, the paper shows clearly that this article of commerce is by no means one of minor importance, and the link between hydrocarbon oils and saponifiable fats and waxes is once again well illustrated by its technical study and description.

Safety of Life from Fire

A USEFUL lecture given by Col. G. Simonds at the Royal Society of Arts on "Safety of Life from Fire" is published in the Society's *Journal* for January 20. The figures given prove that the fire risk to individuals is not large, but as the risk can be almost eliminated by a few simple common-sense rules, it is advisable that they be taught in schools. The best way of doing this is by showing films illustrating the principal dangers and the methods of avoiding them. The dangers to life arise mainly from the products of the fire, namely, smoke and hot gases. During a fire, it is a safe rule never to open a door if a fire is raging the other side. If it is necessary, and the door opens towards you, one hand should be placed on the handle and the other shoulder high on the door. The door can then be opened safely about three inches, the opener being protected from the smoke and gases and so see something of the surroundings. If necessary, the door can be shut quite easily. To go through smoke one should crawl on the hands and knees keeping the mouth as close to the floor as possible. When coming down a staircase through fire or smoke one should keep as close to the wall as possible and if it is necessary to crawl, come down feet first. A person whose clothes are on fire should never be allowed to remain standing for

a moment. Fatalities nearly always arise from the shock of burning about the face and head. If they should start to run they should be tripped up and rolled on the floor in a coat or a blanket if possible. The new tannic acid treatment for burns has proved very successful, as shown by Dr. Philip H. Mitchiner in his Hunterian lecture delivered before the Royal College of Surgeons on February 1 (*Lancet*, Feb. 4, p. 233). The results of its use show a very decided percentage drop in the number of fatal cases. People should be warned about the dangers of cleaning with petrol as the number of fatalities due to this cause is increasing.

Ultra-Short-Wave Radio Research

Two papers, communicated by the General Electric Co.'s research laboratories at Wembley, were read to the Radio Section of the Institution of Electrical Engineers on January 4 by Mr. E. C. S. Megaw. The first paper gives a critical summary of the existing knowledge of electronic oscillations. The methods of their production are outlined and their applications to radio communication are described. Using these oscillators and parabolic reflectors, Beauvais obtained in 1930 a maximum range of telegraphic transmission of about 25 miles from the top of the Eiffel Tower. In the Dover-Calais demonstrations of the International Telegraph and Telephone Laboratories (March 31, 1931) duplex telephony was achieved over a similar distance. In the second paper, possible methods of utilising magnetrons to generate short-wave oscillations are indicated and the more important of the results obtained by previous workers are described. Experimental investigations were undertaken to discover the relations between electron and dynatron types of oscillation. For electronic oscillations it was found that the experimental results are entirely in agreement with theory in those cases where it is applicable. The investigation of the simple dynatron oscillations showed that the static characteristics exhibited a negative resistance effect. During oscillations it was found that the anode current may exceed the original total emission current. This is considered to be due to the bombardment of the filaments by electrons which return to it with considerable velocity. The shortest wave-length obtained by means of dynatron oscillations was about thirty centimetres. At this wave-length the power attainable was about a tenth of a watt. It is concluded that for wave-lengths less than about fifty centimetres electronic oscillations give the greatest output.

Mortality from Whooping Cough

IN a paper read at a meeting of the Royal Statistical Society on February 21, Dr. Bradford Hill pointed out that, in modern times, mortality from whooping cough in England and Wales has shown a remarkable decline, the death rate in the years 1921-30 being only one-third of that recorded in 1861-70. In spite of this improvement it remains a very important cause of child mortality. In 1921-30 it was responsible in England and Wales for no less than 44,000 deaths,

or nearly 1 per cent of the total mortality of the population. The mortality falls mainly upon the first two years of life, while, in 1921-30, more than 90 per cent of the deaths were concentrated on the first five years, a ratio which was equally true at the end of the eighteenth century. In view of this concentration upon very young children, steps to control it are earnestly to be desired. One of the most curious anomalies of whooping-cough mortality, which has long been recognised, is the consistently heavier mortality of female children. Various attempts have been made in the past to explain this, for example, in terms of the sex differences in the formation and development of the larynx, sex differences in sensitiveness of the nervous system, but none of the hypotheses so far put forward seems, on careful examination, to be adequate.

ANOTHER curious feature of the mortality of infants from whooping cough is the lower death rates of illegitimate infants, when compared with the legitimate, in the first three months of life, while at the same age lower death rates are found in urban districts when compared with rural. An abnormal characteristic of the epidemiology of the disease, that has existed for at least three quarters of a century, is the increasing proportion of early deaths with decreasing urbanisation. This feature of the disease is not shown by measles. The latter acts according to 'expectation', namely, the more the 'overcrowding' the earlier the liability to attack and death. Yet whooping-cough statistics for England and Wales suggest the reverse. The relative importance to-day of whooping cough as a cause of widespread sickness and death is perhaps still under-rated, and further steps to combat it are required.

British Claims in the Antarctic

By an Order in Council dated February 7 and published in the *London Gazette* of February 14, a sector of the antarctic comprising an extent of one hundred and fifteen degrees of longitude and covering more than a quarter of the antarctic continent has been placed under the authority of the Commonwealth of Australia. The *Times* reports the order as stating that "that part of the territory in Antarctic Seas which comprises all the islands and territories other than Adélie Land situated south of the 60th degree of South Latitude and lying between 160° E. and 45° E. is territory over which His Majesty has sovereign rights". The order comes into force when the necessary legislation has been passed by the Commonwealth Parliament. Adélie Land was claimed by France in 1924 but its boundaries were not defined. The new territory adjoins the Ross Dependency of New Zealand on the east and extends from Oates Land through King George, Wilkes, Banzare, Knox, Queen Mary, Wilhelm, and Mac-Robertson Lands to Enderby Land, beyond which Norwegian discoveries link it to Coats Land. The coasts of most of the territory were discovered by British, including Australian, and American explorers. The glaciated interior is unknown. No one name is

in use for the whole of the area. The only commercial value of the coasts is for whaling.

The Shrimp Industry of Leigh-on-Sea

UNDER this title Mr. A. Laurence Wells has written a long and comprehensive account of this once important industry of the Thames Estuary (*Southend Standard*, Dec. 29, 1932, Jan. 5 and 12, 1933). Unfortunately, shrimping at Leigh has steadily dwindled since the beginning of this century. From six boats in 1832, the numbers rose to a hundred in 1850 and two hundred in 1875, dropping from 1905 to the present time, when there are only sixteen shrimpers among the forty boats engaged in fishing activities. These records of a vanishing industry are well worth preserving and Mr. Wells with the help of the manuscript notes now safely preserved in the Southend Museum made by the late Dr. James Murie gives us a most interesting survey both historical and biological. The term 'shrimp' embraces several species which are all described and differentiated. Thus from this district we have the common 'brown shrimp', the original shrimp of commerce, at first the only kind fished; the 'banded shrimp', the 'yellow shrimp' and the 'channelled shrimp'. Besides these true shrimps there is the 'pink shrimp' which, though not a prawn, is prawn-like, and four species of real prawns. Finally, there is *Nika edulis*, the so-called 'Risso's shrimp' which, although rather rare, is very good to eat. Each of these has its own individual habitat. Their life-histories are different and the fisherman knows a great deal about them which is not known to the general naturalist. There is much valuable information in this series of articles which all interested would do well to study.

Aquaria

THE importance of observing the hydrogen ion concentration in the aquarium is now fully recognised. Both the *Aquarist and Pond Keeper* of January-February 1933, and the *Aquarium Review* of December 1932, include articles on this subject ("PH Values, Their Meaning and their Significance to the Aquarist", by J. F. Corrigan. "The Aquarium and pH" by L. C. Mandeville). The same number of the *Aquarist* contains notes from the Brighton Aquarium by the Curator, Mr. George W. Weller, and notes from the Zoological Society's aquarium by the Director, Mr. E. G. Boulenger. In the Brighton Aquarium there are now living one hundred and twenty herrings; also an angler, *Lophius piscatorius*, which is very difficult to keep alive and one of the most voracious of all fishes. Mr. Lester L. Swift gives a very interesting account of the American tropical fishes belonging to the genus *Mollienesia*, and how to keep and rear them. These fishes are viviparous but somewhat difficult and irregular in breeding in captivity. They require much vegetable food as well as animal, and a certain kind of slimy alga, known as 'frog-spit', is apparently essential to the raising of healthy broods. A female may have 2-10 young every few days for a month or she may have a litter once a year or once a month for several months in succession.

Journal of Chemical Physics

THE first number of the new American *Journal of Chemical Physics*, which is published by the American Institute of Physics and has an editorial board comprising the leading American chemists and physicists, contains a number of important papers. In a brief editorial introduction, Prof. H. C. Urey, the managing editor, states that the journal caters for an increasing number of investigators who are working on subjects on the border-line between physics and chemistry, who have a broad knowledge of both sciences and are using methods of investigation which belong neither to classical chemistry nor to traditional physics. The papers in the new journal, which has an attractive format and is well printed in double-column pages, include contributions by Langmuir on an extension of the phase rule for adsorption, by Debye on the mass of electrolytic ions, by G. N. Lewis on the chemical bond, by Harkins and Jackson on a spectroscopic study of the decomposition and synthesis of organic compounds by electrical discharges, by Pauling on helium molecule ions, and several other important communications on physics and physical chemistry. It is clear that a high standard has been set in the new journal, and although the multiplicity of chemical and physico-chemical journals, especially in Germany and the United States, presents a serious economic problem to scientific institutions, the *Journal of Chemical Physics* should be welcomed as an authoritative medium for the publication of work which is interesting both to chemists and physicists.

World Petroleum Congress

A WORLD Petroleum Congress, organised by the Institution of Petroleum Technologists, is to be held in London on July 19-25. Membership is open to all persons connected with, and interested in, the petroleum industry, at a nominal fee of 10s. It is proposed to hold the sessions of the Congress at the Imperial College of Science and Technology, South Kensington, and the scope of activities on this occasion includes the reading of various technical papers, a private view of the International Oil Industry's Exhibition, exhibition of films illustrating the petroleum industry and sundry social arrangements. Foreign delegates from all important oil-producing countries are being invited and the Congress will offer an excellent opportunity for the interchange of ideas, both technical and economical. Broadly speaking, the technical programme will embrace four main sections of the industry, geological, engineering, refining and chemical, and standardisation. From the preliminary announcements available, it would seem that this Congress, by its purpose and very wide appeal, will be one of the most important international functions affecting the petroleum industry which has been held for many years, and it is a matter of gratification that, on this occasion, it has both a British sponsorship and setting.

Atoms, Molecules and the Atmosphere

FOR his presidential address before the Royal Meteorological Society, on February 15, Prof.

S. Chapman took as his subject, "Atoms, Molecules and the Atmosphere". While the molecular constitution of air can be ignored in considering most meteorological problems of the lower atmosphere, it is of great importance for the phenomena of the upper atmosphere. The remarkable advances made in recent years in our knowledge of the intimate constitution of matter bear closely on many problems of upper-atmospheric physics. For this reason a broad summary of modern views on atomic and molecular structure was given, bearing on their states of excitation, ionisation, and dissociation, on the spectra that they emit, and on the effects of impacts between particles of various kinds, electrons, atoms, molecules and ions. Brief mention was made of some atmospheric phenomena in which such considerations are of importance—the spectra of the aurora, and of absorption bands produced by oxygen, ozone, and water; the dissociation of oxygen in the upper atmosphere; and the ionisation of the upper air.

Gypsy Art in Russia

AFTER a period of eclipse following the revolution, the characteristic music of the Russian Gypsies has been revived on lines, it is claimed, more in accordance with its distinctive racial peculiarities than were the Russianised music and singing of the town Gypsies popular under the Tsarist regime. According to an account by M. A. Barannikov (*J. Gypsy Lore Soc.*, ser. 3, vol. 13, pts. 3-4) of Russian gypsy singers of to-day, the Ethnographical Department of the Russian Museum, Leningrad, has formed a gypsy choir selected from both town and nomad Gypsies, of which the repertoire includes all types of gypsy music from the traditional songs of the nomads—in the original form in which they had never been sung by the choirs of town Gypsies—to the Tsigane settings of modern music. Performances have been given in the State Theatre of the Ethnographical Department, of which the object is the preservation, study and presentation of the folk dances, songs and music of the various races under Soviet rule, such as, for example, the peoples of the Caucasus and the Ukraine and even, on occasion, of Turkestan. A similar gypsy studio is now attached to the State Theatre of Moscow.

Progress of Birth Control

THE second annual report, for 1931-32, of the National Birth Control Association has been issued by the Committee. The work of the Association has proceeded vigorously and has been stimulated by the general economic distress in Great Britain. Speakers on the subject of birth control have been supplied for meetings of various organisations. The Birth Control Investigation Committee is incorporated with the Association and investigations on spermaticides, contraceptive appliances, and statistics of birth control have been pursued. Local authorities the number of 47 have decided to provide birth control advice within the terms of the Ministry of Health Circular No. 1208 of 1931. Terms of membership of the Association may be obtained from the Secretary, 26 Eccleston Street, London, S.W.1.

Greenkeeping Research

THE Golf Green Research Station at St. Ives, Bingley, continues its investigations into problems connected with the management of lawns. Vol. 2, No. 7 of its journal has recently appeared, and contains articles on "The Management of Golfing Turf on Heavy Soil" by G. Samuels, "Mole Draining of Golf Courses on Heavy Land" by R. B. Dawson, "Composts and Fertilisers in Relation to Greenkeeping" by T. W. Evans, "A Greenkeeper's Guide to the Grasses" by I. G. Lewis, and "Common Weeds of Turf" by R. B. Dawson. The Station has already made outstanding contributions to our knowledge of the ecology of the grasses which are used for lawns. Mr. R. B. Dawson and Dr. T. W. Evans have revolutionised our methods of manuring lawns, both of golf greens and garden and are substituting scientific knowledge for the 'rule of thumb' methods or the absence of methods, of the past. The journal may be obtained from the St. Ives Research Station, Bingley, Yorks., price 2s. 6d. per number.

Announcements

SIR ROBERT HADFIELD has been elected an honorary member of the Academy of Sciences of the U.S.S.R. in recognition of his work for metallurgy. The Soviet Ambassador in London, Mr. I. Maisky, is giving a luncheon in honour of the occasion on February 28.

MR. KENNETH HEADLAM-MORLEY has been appointed secretary of the Iron and Steel Institute in succession to Mr. G. C. Lloyd, who will retire shortly. Mr. Headlam-Morley was educated at Eton and Oxford, where he was a scholar at New College. He joined the staff of Messrs. Dorman Long and Co. Ltd. in 1925; after a technical training in their iron and steel works at Middlesbrough he has been occupied in their Secretarial, Managing Director's and By-Products Departments, and is well acquainted with the iron and steel industry of western Europe.

At the annual general meeting of the Quekett Microscopical Club, held at 11, Chandos Street, Cavendish Square, W.1, on February 14, the following officers were elected: *President*: Mr. J. Milton Offord; *Vice-Presidents*: Mr. J. Wilson, Mr. C. D. Soar, Mr. J. Ramsbottom, Mr. E. A. Robins; *Treasurer*: Mr. C. H. Bestow; *Secretary*: Mr. W. S. Warton; *Reporter*: Mr. A. Morley-Jones; *Librarian*: Mr. C. H. Caffyn; *Curator*: Mr. C. J. Sidwell; *Editor*: Mr. W. S. Warton; *New Members of Committee*: Messrs. D. Bryce, W. J. Ireland, E. K. Maxwell, and E. C. Reeve.

A COURSE of six lectures on the design of photographic objectives will be given by Dr. W. D. Wright on Tuesdays and Thursdays commencing on February 28, at the Imperial College of Science and Technology, South Kensington, S.W.7. Further particulars can be obtained from the Registrar of the College.

MR. V. J. P. DE BLOCQ VAN KUFFELER, director of the Zuider Zee Works, will deliver an illustrated lecture, in aid of King Edward's Hospital Fund for London, on March 3, describing the way in which the reclamation of the Zuider Zee has been carried out under his supervision. The lecture will be at 5.30, at Drapers' Hall, Throgmorton Street, E.C.2. Admission will be by ticket obtainable either from the Secretary, King Edward's Hospital Fund for London, 7, Walbrook, E.C.4; or from Messrs. Alfred Hays, Ltd., 74, Cornhill, E.C.2; 26, Old Bond Street, W.1; and 62, Strand, W.C.2 but not at the doors.

WE have received from the Association of British Chemical Manufacturers and from the British Chemical Plant Manufacturers' Association, both of 166 Piccadilly, London, W.1, two publications entitled "British Chemicals 1933" and "Official Directory of Members 1933", respectively. These give the names and addresses of firms from whom various chemicals and types of plant are obtainable. The book on British chemicals is printed in several European languages. Copies may be obtained on application to the Association at the above address.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Building Research Station, Garston—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Feb. 28). A head of the School of Photography at the Polytechnic, Regent Street, London, W.1—The Director of Education (March 3). A teacher of engineering subjects and a teacher of mathematics at the Acton Technical College—H. M. Walton, Education Offices (H.), 10, Great George Street, London, S.W.1 (March 6). Two agricultural inspectors for the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (March 6). A research assistant in mental deficiency at the Royal Eastern Counties' Institution, Colchester—The Medical Superintendent, Royal Institution, Colchester (March 11). An assistant lecturer in geography at the University of Manchester—The Registrar (March 15). A Channing Wills professor of geology at the University of Bristol—The Registrar (March 16). Three probationary assistant engineers in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (March 16). A lecturer in geology at the University of Durham (Durham Division)—The Head of the Department of Science (March 20). A lecturer in medicine at the University of Aberdeen—The Secretary (March 21). A scientific assistant at the Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge—The Director (March 30). Assistant examiners in the Patent Office—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (June 1).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Rubber Research

MANY technologists other than those directly interested in rubber manufacture will have read with feelings of profound misgiving the leading article in NATURE of February 11. The closing down of the Rubber Research Laboratory at Croydon and the dispersal of its fine library—one of the most complete special technical collections in Europe—would be nothing short of a catastrophe. For this is no moribund institution, but an active and extremely useful organisation discharging efficiently those duties and fulfilling those aims for which the industrial research associations were called into being.

Referring to the penultimate paragraph of the article, in which allusion is made to the benefits and obligations conferred upon industries by protection, it is only fair to state that the rubber manufacturing industry as a whole realises the benefits of co-operative research and accepts its obligations to maintain itself in a state of efficiency. It is therefore prepared to support the levy scheme as embodied in the Rubber Industry Bill, which it regards as the only workable scheme for securing the financial support necessary for the continuance of the Rubber Research Association. The fact that the Research Association numbers amongst its members no less than 86 rubber firms, including some of the largest in the country, affords ample evidence of the attitude of the majority of the industry in regard to the levy scheme and the Rubber Industry Bill. Yet, despite this preponderance of favourable opinion, the fact that the measure has perforce to be introduced into the House of Commons as a private member's Bill, apparently places it at the mercy of a minority opposition. Surely, in these circumstances, the efforts of the majority deserve the support not only of the Government, but also of all who have at heart the industrial progress of the future.

Regarding the volume and the character of the work which the Research Association has accomplished during the past thirteen years, I can speak with some knowledge. As chief chemist to a firm which has supported the Association throughout and as one well acquainted with its various activities, I can testify, as can many others in similar positions, to the very great practical value and usefulness of the many investigations which have been undertaken, and the results which have been obtained. Concerning the library side, it would be almost impossible to over-rate the value of the services rendered by the Association in the systematic collection, co-ordination and distribution of an enormous amount of scientific and technical information.

A study of the numerous research reports, in which the results of investigations have been published, affords ample evidence of the necessity for a separate organisation for the investigation of the common and fundamental problems of an industry. However well a firm makes provision for the scientific control of its own factory, it can seldom afford the time, staff or equipment required for the adequate

study of these problems. From the point of view of economy also it is advisable that unnecessary repetition and overlapping should be avoided so far as possible and this can be ensured only by co-operation.

Attempts have been made in certain quarters to decry the value of the work of the Association but, so far as I am aware, no such attempts have been made by those who have studied, even superficially, the reports of the work done and results attained. Non-members, not having had this opportunity, can scarcely be considered competent to criticise on these grounds. To the minority who are opposing the Rubber Industry Bill, one would like to put the question: Have you any constructive suggestions as to what shall take the place of the organisation to which you object? It may be taken for granted that the objection is to co-operative research in principle.

What will be the effect if this opposition is successful in wrecking or unduly delaying the Bill? This Rubber Research Association, with its valuable plant and specially trained staff, its undeniable record of accomplishment, its library and its great potentialities for future service, will cease to exist. To the rubber industry this will be an irreparable loss, but it will have a far greater significance than that. It will be another blow, and possibly a knock-out blow, to the national movement for co-operative industrial research in connexion with which the Government itself has expended more than a million pounds.

Should the Bill pass to the statute book, however, the occasion may well mark the beginning of a new era for industrial research in which every industry will be able, without external assistance, to maintain and control a research organisation for investigating its own particular problems and for making contact, when necessary, with the similar organisations in other industries.

S. S. PICKLES
(Chief Chemist).

George Spencer, Moulton and Co., Ltd.,
Bradford-on-Avon,
Wiltshire.
Feb. 14.

Hexuronic (Ascorbic) Acid as the Antiscorbutic Factor, and its Chemical Determination

ALTHOUGH it is known that specimens of hexuronic acid (since renamed ascorbic acid) possess antiscorbutic properties, it has remained to show whether this activity was an inherent property of the pure substance itself or ascribable to some associated impurity. Experiments to test the point have been carried out in this laboratory, as a result of which a very extensive and constant correlation has been established between vitamin C activity and hexuronic acid. Little doubt can therefore remain as to the identity of the two substances.

Our evidence may be summarised as follows:—
(1) In preliminary work it was shown that the antiscorbutic activities of several natural sources ran approximately proportional to the amounts of hexuronic acid recoverable from them: thus suprarenal cortex (ox), not hitherto recognised as an antiscorbutic, had three times the potency of orange juice. (2) Specimens of hexuronic acid from different sources (suprarenal; paprika) were then assayed, and were found to have identical antiscorbutic

activity. (3) Hexuronic acid after various repurification processes maintained its original activity. (4) The hexuronic acid contents of numerous natural sources were then determined chemically (by the method described below) and were found to account precisely for their known antiscorbutic activities. (5) In the case of several materials it was also possible to estimate the hexuronic acid content by intensity of absorption at 265 μ (carried out by W. J. Dann), and this result was in further agreement with the biological or chemical tests. (6) The destruction of hexuronic acid by heat and aeration as measured chemically was found to proceed at a rate similar to that of vitamin C activity. (7) In the guinea pig the antiscorbutic activity of the suprarenal (or liver) was lost with the development of scurvy and this coincided with the disappearance of hexuronic acid. (8) With other species, the rat or dog, which are able to synthesise their own vitamin when none is provided in the diet, the antiscorbutic activity and the hexuronic acid both remain unaffected.

A rapid micro-chemical method has been devised for estimating the hexuronic acid content of foods, involving preliminary extraction with trichloroacetic acid and titration against the oxidation-reduction indicator, 2, 6-dichlorophenolindophenol in acid solution. Certain naturally occurring reducing reagents, which were found to react when the reducing capacity of foodstuffs was determined according to the Tillmans technique in more neutral solution, did not interfere by this method (special precautions, however, being necessary in the presence of adrenaline). Sensitivity is about 1 part in 30; an amount of vitamin C represented by 0.03 c.c. of orange juice suffices for an accurate assay; and the determination requires only a few minutes to carry out. Results coincide with those obtained biologically. Values below are expressed as the 'minimal protective day dose' for guinea pig (figures in brackets being the determined or reputed values as measured biologically):

Cabbage 0.9 (1); watercress 1.3 (1); lemon juice 1.5, 1.5 (1.5); orange juice, several types 1.2, 1.5, 1.9 (1.5); grape fruit juice 1.4, 1.5 (1.5-2); pineapple juice 3 (2-3); imported tomato, juice of 4.3 (3-5); banana 6 (5-10); potato 6 (6-10); rhubarb 15 (12); carrots 32 (10-35); grapes 30 or above (> 20, 40); imported peach, juice of > 60 (-).

Horse-radish 0.6 (-).

Apples:—Bramley's seedling, cortex 5.5 (3-5), peel 1.2 (1); Newton, cortex 17 (10), peel 3.7 (3); Blenheim orange, cortex 29, peel 2.7; Edward VII, cortex 53 (> 20), peel 7.5 (2?); Cox's orange, cortex 56 (> 20), peel 10 (-).

Ox suprarenal cortex 0.5 (0.5); ox liver 1.3 (< 3); cows' milk 47 (20-60); "Ostermalt" 3.3 (-).

The exact antiscorbutic activity of hexuronic acid has been determined by several alternative methods (curative, tooth structure and preventive): 1.0 c.c. orange juice = 0.5 ± 0.15 mgm. hexuronic acid (or best values = 0.6 mgm.). We recommend its adoption as an international standard.

T. W. BIRCH.
LESLIE J. HARRIS.
S. N. RAY.

Nutritional Laboratory,
Cambridge.
Feb. 10.

THE conclusion having been reached that vitamin C is identical with hexuronic acid, it becomes of obvious importance in the first place to see how this can be reconciled with Zilva's contention¹ that there is a lack of parallelism between antiscorbutic activity and reducing capacity—one of the most characteristic properties of hexuronic acid. Fig. 1 summarises all the data given by Zilva, mean values for antiscorbutic potencies being plotted at each level of reducing capacity. Bearing in mind

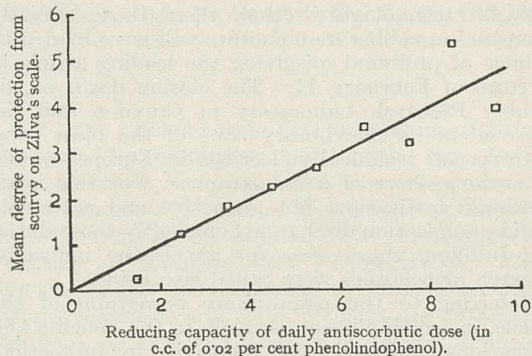


FIG. 1. Relation between reducing capacity and antiscorbutic activity.

the unavoidable variation in biological response between individual experimental animals, it becomes evident that Zilva's data, once they are analysed in this way, appear in fact to afford good evidence of a close quantitative relation between reducing capacity and antiscorbutic activity in lemon juice fractions, and therefore are not at variance with the hypothesis that hexuronic acid and vitamin C are identical.

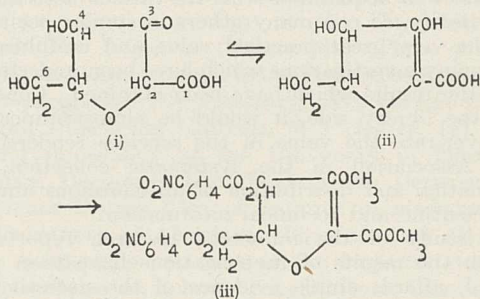
Biochemical Laboratory,
Cambridge.
Feb. 10.

W. J. DANN.

¹ Zilva, *Biochem. J.*, 28, 1624; 1932.

Constitution of Vitamin C

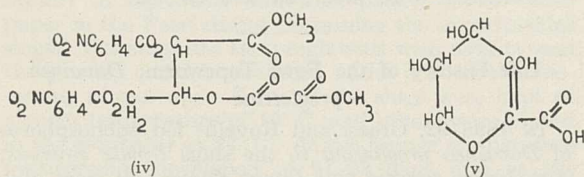
IN our first communication¹ we proposed the formulation of vitamin C as a furane- or cyclopentane-derivative. In consideration of further investigations which we have made, we now consider the furane type of structure (i and ii) well established. This conclusion rests upon the following observations; neither the dimethylvitamin nor the di(nitrobenzoyl)-dimethylvitamin (iii) contains a carbonyl group. The



double bond in (iii), which does not react with bromine or with permanganate, is attacked by ozone to give a neutral product, melting point 162°, which does not react with ketone reagents. Its composition is

$C_6H_4O_2(OCH_3)_2(OCOC_6H_4NO_2)_2$. (Mol. wt. in camphor and in benzene.)

Since no reduction in the size of the molecule has occurred, the double bond must exist in a ring. Further, since neither carbonyl nor free carboxyl groups are produced, both the carbon atoms associated with the double bond must be attached to ether-linked oxygen atoms. The ozonisation product is thus formulated as (iv), as the methyl ester of a trihydroxybutyric acid, in which two of the hydroxyl groups are esterified with *p*-nitrobenzoic acid and the third with oxalic acid monomethylester.



In agreement with this, five equivalents of alkali are used in its hydrolysis. The oxalic acid so produced was collected as calcium oxalate and after re-solution titrated with permanganate. The trihydroxybutyric acid is optically active, but its examination is not yet completed. The powerful reducing properties of the vitamin are related to the H-atom, attached to the C_2 -atom, which may be readily oxidised to hydroxyl. Its replacement by CH_3 , in the enol-form (ii), gives rise in the case of the dimethylvitamin, to a substance stable to oxidising agents. Since the oxidation product is a furanose derivative, its great reactivity is understandable. Besides the structure (i) (and ii), the structure (v), with its corresponding enol-form, may also be possible. In consideration, however, of the observations of Cox, Hirst and Reynolds² (production of *d*-threonic acid by permanganate oxidation; formation of furfural) the formula (v) is excluded (it would yield erythronic acid, since the vitamin gives a monoacetone derivative). Since we have examined the constitution by the mildest chemical methods, secondary changes in this most reactive molecule are excluded. A detailed communication will appear elsewhere³.

FRITZ MICHEEL.
KURT KRAFT.

Allgemeines Chemisches Universitätslaboratorium,
Göttingen.
Jan. 29.

¹ 1st communication, *Naturwiss.*, 21, 63; 1933.

² NATURE, 130, 888, Dec. 10, 1932.

³ The substance of this letter was communicated to the Göttingen Chemical Society on January 28.

A Carotene Derivative giving with Antimony Trichloride an Absorption Band at 610-630 $m\mu$.

CAROTENE and vitamin A share with a variety of polyene substances the property of giving a blue solution with antimony trichloride in chloroform. Spectroscopical research shows that carotene gives a specific absorption band with a maximum at 583-590 $m\mu$, whereas vitamin A gives a maximum absorption band at 606-620 $m\mu$ with the antimony trichloride reagent.

It is very probable that carotene is converted into vitamin A in the body. Until now, it has not been possible to obtain this reaction *in vitro* by purely chemical treatment.

Recently we have obtained a carotene derivative with an absorption band at 610-630 $m\mu$ with the Carr and Price reagent. 150 mgm. of carotene (from carrots) is boiled under a reflux condenser for 15 minutes with a mixture of 100 c.c. of acetone and 1 c.c. of hydriodic acid (sp.gr. 1.7). After cooling to room temperature, 150 c.c. of petroleum ether is added and the acetone washed away with water. The petroleum ether solution is vigorously shaken up for some time with a strong sodium thiosulphate solution. With antimony trichloride in chloroform (with addition of one drop of acetic acid anhydride) a blue colour develops with absorption down to 640 $m\mu$.

The petroleum ether solution, to which is added 20 c.c. of 1 per cent sulphuric acid, is shaken up with small quantities of a dilute (1 per cent) sodium nitrite solution, testing from time to time with the antimony trichloride reagent. A strong absorption band at 610-630 $m\mu$ appears. A product with maximum absorption is approximately reached when the colour of the petroleum ether solution has nearly disappeared.

Too much sodium nitrite causes a redder Carr and Price reaction, whereas the absorption at 610-630 $m\mu$ decreases.

The substance, although a derivative of carotene and giving the same absorption band as vitamin A, was found to be devoid of growth-promoting activity; small quantities of indol and the inhibitor of cod liver oil caused inhibition of the absorption band.

M. VAN EEKELLEN.
A. EMMERIE.

Laboratory of Hygiene,
University, Utrecht.
Jan. 30.

Induction by Coagulated Organisers in the Chick Embryo

In a series of short communications, Bautzmann, Holtfreter, Spemann and Mangold¹ have recently reported the results of experiments in which they attempted to obtain typical organiser reactions (that is, the induction of a neural plate in the presumptive epidermis in *Triton*) by organisers which had been killed. Marx² had previously demonstrated that inductions could be performed by organisers which had been narcotised by trichlorbutyl alcohol to such an extent that they degenerated and were absorbed, while Spemann³ had obtained inductions by organisers which had been crushed, but not by those which had been frozen or dried.

Holtfreter has been by far the most successful of the newer workers; he reports large and typical inductions by organisers dried at 60°C., or heated to 100°C., or frozen, acting upon either isolated pieces of presumptive epidermis or on the same tissue in its normal place in the embryo. Bautzmann describes two structures, induced by organisers which had been heated to about 60°C., which he is inclined to interpret, now that the possibility has been proved by Holtfreter, as atypical induced neural plates. Spemann has obtained one induction by an organiser killed in 96 per cent alcohol, and Mangold reports some doubtful cases which raise the possibility that the inducing agent can diffuse into agar blocks.

Since October 1931 I have been attempting to obtain inductions by dead organisers in the chick embryo, the organisers being killed either by heat or by acetone. But it was usually found that the dead implanted substance became enveloped by

mesenchyme or endoderm cells from the host, and was thus insulated, as it were, from the host ectoderm, so that no inductive effect was obtained or could be expected. The insulation is least efficient in the comparatively mesoderm-free region near the head, but in this situation there is great danger of an induced neural plate becoming incorporated into the host's neural plate and therefore indistinguishable. Two fairly clear inductions have, however, been obtained in this region. In both cases the graft consisted of the anterior part of a chick primitive streak, and was coagulated by being placed, as dry as possible, in a thin-walled glass tube which was then dipped in rapidly boiling water for about 30 seconds.

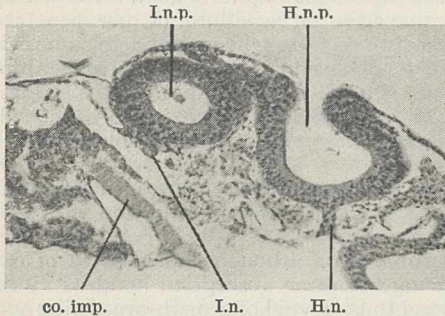


FIG. 1. Section through posterior part of induction. I.n.p., induced neural plate; H.n.p., host neural plate; I.n., induced notochord; H.n., host notochord; co. imp., coagulated implant.

This treatment left the tissue in a hard, almost horny condition: sections show that it has been completely coagulated, and not merely rendered necrotic. In one case the induced neural plate is united throughout its length with the host plate; the combined structure is very asymmetrical and in its folding shows clear indications that it consists of two parallel plates which have united laterally. In the second, and more diagrammatic case, the induced plate is again united with the host plate in the anterior region, but farther posteriorly, at the level of the hind-brain, it is quite separate and is accompanied by an induced notochord (Fig. 1). The presence of the induced notochord shows that we are not dealing, as Spemann concluded for the amphibian experiments, merely with the "Umschlag von präsumptiver Epidermis in Medullarsubstanz", but on the contrary, that the embryonic axes induced in this way may include several, perhaps all, of the axial organs: in fact, that the induced axis has its own "individuation field"⁴. From Holtfreter's account one would have thought that the same was true in the Amphibia.

Although it is perhaps not difficult to imagine the mere presence of a new individuation field being induced by a dead organiser, it is much more difficult to believe that dead material could determine the regional character of the induced field: and in the specimen described it probably has not done so. This is suggested by the fact that the induced notochord extends exactly as far towards the anterior as the host notochord, indicating that the induced axis owes its regional structure to the host. I have recently⁴ argued that in normal inductions by living organisers the regional structure of the induced field is determined by the host and the graft working together. It would be very interesting to observe the regional character of neural plates induced by dead organisers near the edge of the area pellucida,

where the host's influence is very small and can be overcome by that of a living graft; but as yet all dead grafts in such situations have become enveloped by cells from the endoderm.

C. H. WADDINGTON.

Strangeways Research Laboratory
and Laboratory of Experimental Zoology,
Cambridge.
Jan. 24.

¹ Bautzmann, H., Holtfreter, Joh., Spemann, H., Mangold, O., *Naturwissenschaften*, 51, 971; 1932.

² Marx, A., *Arch. Entw.-mech.*, 123, 333; 1931.

³ Spemann, H., *Verh. Zool. Ges.*, 1931.

⁴ Waddington, C. H., *Arch. Entw.-mech.* (in press).

Life-History of the Fowl Tapeworm, *Davainea proglottina*

IN 1888-92, Grassi and Rovelli¹ fed onchospheres of *Davainea proglottina* to the slugs *Limax cinereus*, *Agriolimax agrestis* and *Limax flavus* and were able in less than twenty days to obtain cysticeroids which when fed to hens developed into *D. proglottina*. In spite of these experiments, the authors did not exclude the possibility of direct infection, since they considered that these intermediate hosts were not present in sufficient numbers to account for the very heavy infection of the poultry in Rovellasca where they worked. Railliet and Lucet² attempted to establish direct infection and failed, but they considered that other slugs, in addition to those used by Grassi and Rovelli, could serve as intermediate hosts.

In Great Britain, Meggitt³ attempted to repeat the experiments and fed onchospheres to the following slugs: *Arion ater*, *Arion hortensis*, *Arion circumscriptus* and *Agriolimax agrestis*. After intervals of 10-35 days the slugs were killed and examined but no cysticeroids were obtained. Meggitt did not consider the experiments conclusive since he experienced considerable difficulty in keeping the slugs alive in the laboratory. Later, Joyeux⁴ in France and Bisset⁵ in England again failed to establish *Agriolimax agrestis* as an intermediate host. In the United States, however, Chandler⁶, by feeding proglottids to two specimens of *Agriolimax agrestis* and one of *Limax flavus* was able to obtain cysticeroids, and later Myrna Jones⁷ successfully infected four species of terrestrial snails which are not indigenous to Great Britain.

Only one slug, *Agriolimax agrestis*, was used by all the authors and from their observations it was found to serve as an intermediate host in Italy and the United States but not in France and England. In view of this discrepancy, I proceeded in October 1932 to reinvestigate the life-history with relation to this slug and I have been able to obtain cysticeroids experimentally. Wetzel⁸, who has apparently been working for some time on similar lines in Germany, has recently published an extensive paper on the life-history of *D. proglottina*, and I can confirm his observations on the active migration of the onchospheres through the wall of the alimentary canal of the slug and the subsequent development of the cysticeroids in the body cavity or digestive gland.

In view of the failure of previous experiments in Great Britain, a brief account of the technique adopted may be of interest. As I was unable to breed slugs in the laboratory during the autumn, some two hundred slugs were collected; half of them were examined and found to be free from

infection. The remainder were used in equal numbers for controls and experiments. They were kept in batches of 10 in Petri dishes (4.5 in. in diameter) lined with damp filter paper. Although the slugs will feed on a variety of vegetable foods, in order to eliminate all possibility of outside infection, they were fed on the foliage cut from wheat grown on moist flannel in the laboratory. The Petri dishes were cleaned, and the filter paper and food were replaced daily.

Active ripe proglottids of *D. proglottina* were obtained from the duodenum immediately after an infected hen was killed. The proglottids were washed rapidly in tap water and then placed on the filter paper in the Petri dishes containing the experimental slugs. The slugs ate the proglottids with avidity and the process could be watched under a binocular dissecting microscope. Some of the slugs were kept at a room temperature of 16° C. and others were placed in the incubator at 24° C. At the former temperature cysticercoids developed in 21–22 days and at the latter in 12–13 days. By killing and examining some of the experimental slugs at varying intervals, the route of infection was established and all stages of the development up to and including the cysticercoids were obtained. At the conclusion of the experiments the control slugs were examined and found to be uninfected.

It does not follow that *Agriolimax agrestis* is the only intermediate host in Great Britain, and further experiments will probably confirm Wetzel's observations that in addition to this form and *Limax flavus*, the young stages of *Arion hortensis*, *Arion circumscriptus*, *Arion intermedius*, and *Cepea nemoralis* may serve as intermediate hosts.

F. J. BROWN.

Molteno Institute,
University of Cambridge.
Jan. 28.

¹ *Z. Bakter. I. Orig.*, 3, 1888 and 5; 1889; *Atti Acc. Catania*, 4; 1892.

² *Bull. Soc. Zool. France*; 1892.

³ *Parasitology*, 8; 1916.

⁴ *Bull. biol. France et Belg.*, Suppl. 2; 1920.

⁵ *Vet. J.*; 1928.

⁶ *Trans. Amer. Micro. Soc.*, 42; 1923.

⁷ *J. Parasitol.*, 15; 1929.

⁸ *Arch. Tierheilkunde*, 65, Heft 6; 1932.

Phytophthora megasperma causing Pink Rot of the Potato

DURING the course of an investigation into the occurrence and distribution of pink rot of the potato in Northern Ireland, a species of *Phytophthora* other than *P. erythroseptica*, the normal cause of the disease in the field, was isolated from tubers involved in an outbreak of the disease at Culnafay, County Antrim. Numerous isolations made between 1928 and 1932 from diseased tubers occurring in the same field at Culnafay have proved to be *P. erythroseptica*, the species referred to having been obtained on one occasion only. The isolation was made in January, 1930. A series of inoculation experiments has shown that this species causes a tuber rot of the potato indistinguishable from that caused by *P. erythroseptica*. The isolation was found to differ from *P. erythroseptica* mainly by the production of a preponderance of paragynous antheridia and in the large size of its oospores. We are grateful to Mr. Ashby of the Imperial Mycological Institute who has identified it as *P. megasperma* Drechsler.

P. megasperma was first recorded by Drechsler in 1931 as causing a crown rot of hollyhocks in the United States¹ and it would appear that this is the first record of its occurrence outside the United States. Although a number of species of *Phytophthora* will cause pink rot of the potato under conditions obtaining in the laboratory yet, in Northern Ireland, no species other than *P. erythroseptica*, to which must now be added *P. megasperma*, has been found as the cause of the disease in the field.

H. CAIRNS.

A. E. MUSKETT.

The Queen's University,
Belfast.
Jan. 17.

¹ Drechsler, C., *J. Washington Acad. Sci.*, 21, 513–526; 1931.

Snails and Changes in Sea-Level

IN NATURE of April 7, 1923, p. 464, I directed attention to the great changes in sea-level assumed by some geologists to have occurred during Pleistocene times. Reference was made to the small I. de Cima, close to Porto Santo, in the Madeira group. This islet has a very distinct species of snail, in great abundance, and if the postulated changes in sea-level actually occurred, it is hard to understand why the snail did not reach the main island, or, at another time, perhaps perish beneath the waves.

There has recently been published a still more striking example of a snail fauna on a small island, distinct from that on the adjacent larger island. Dr. A. Wetmore and Mr. F. C. Lincoln in 1931 visited Beata Island, which lies about six miles off Beata Point, the southern end of the island of Haiti. Beata Island is connected with Haiti by a submarine bank, on which there is 12–18 ft. of water. It is about four and a half miles long, and four wide. The U.S. Pilot gives an elevation of 330 ft. for Beata, but Wetmore and Lincoln estimated it to be about 75–100 ft. The island is of limestone, and much eroded.

A collection of land snails from Beata Island was submitted to Dr. P. Bartsch, of the U.S. National Museum, with the following astonishing result: *Chondropoma*: two new species, one representing a new subgenus; *Lucidella*: one new species; *Eutrochatella*: two new species; *Ceratodiscus*: one new species; *Cepolis*: two new species and a new subspecies; *Plagiopycha*: one new species; *Thysanophora*: two new species; *Urocoptis*: one new species; *Brachypodella*: one new species; *Macroceramus*: one new species; *Varicella*: one new species.

Thus the whole snail fauna is apparently peculiar to this small island, separated from the main island of Haiti by a channel said to be as shallow as 18 ft. Here is certainly a problem for the geologists.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado.
Jan. 20.

Amplification of the Ionisation Produced by Radioactive Sources

VARIOUS devices have been described for employing thermionic valves to measure small current. In most of these, the necessary sensitivity is only obtained by using very sensitive galvanometers in the anode

circuit of the amplifying valve, which magnify all irregularities due to faulty filament and anode batteries, as well as 'zero creep' effects due to leakage or accumulation of wall charges. Compensation for anode battery fluctuations can be eliminated by the 'valve bridge' method, but such an arrangement, whilst considerably complicating the circuits, only partly removes the causes of unsteadiness, so that a comparatively low limit of sensitivity is attainable, under steady conditions.

The electrometer valve, which has a grid filament resistance of the order 10^{15} ohms, provides a method of measuring ionisation effects, which seems superior to other valve methods so far described, and compares very favourably with the ordinary standard electrometer methods up to a sensitivity corresponding to 500 divisions per volt.

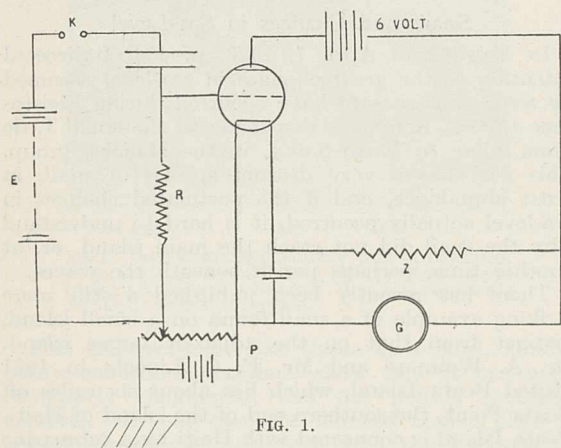


FIG. 1.

The circuit is shown in Fig. 1. A high resistance leak R of the order 10^{12} ohms is placed in the grid-filament circuit, and the ionisation current c flows through this leak to earth, thereby producing a steady potential cR volts across the grid, and a variation of mcR microamp. in the steady anode current of the valve. The normal anode current, when the key K is open, is balanced by the shunt circuit GZ . The mutual conductance m of the valve (G.E.C. type) is about 50 microamp. per volt, when the grid bias is -4 volts. Using a galvanometer of 10 divisions per microampere, a single division of the scale corresponds, therefore, to an ionisation current variation of 2×10^{-15} amp. This sensitivity can obviously be increased by using a still higher resistance leak.

Several tests have been made on the ordinary laboratory ionisation experiments and perfectly steady conditions have been obtained over long periods of working. The apparatus has been constructed in a small tin-lined box, fitted with an ebonite panel in which the anode and filament resistances were mounted. To ensure good insulation, the grid lead is brought out through a sulphur plug, and a vessel containing phosphorus pentoxide is placed within the box to keep the glass surface of the valve and leak as dry as possible.

No disturbance from external electromagnetic effects have been encountered, although tests were made when X-ray installations were in operation within the building, and the zero keeps perfectly steady over long periods. Since the anode voltage required is low (6 volts), large capacity cells can be used to minimise fluctuations in normal anode

current. The high resistance leaks are best made from xylol-alcohol mixtures contained in narrow sealed tubes, and embedded in paraffin wax to improve external insulation. A potentiometer can be inserted as shown, if a null method of measurement is required.

In a recent test on the rate of decay of thorium, a galvanometer of sensitivity 100 divisions per microampere was employed, the sensitivity of the instrument being thereby increased ten-fold. A tendency for 'zero-creep' was observed. This is rapid when the potentials are first applied to the valve, but gradually decreases and becomes very slow (about 1 mm. per minute) after some time. This creep would appear to be due to leakage or accumulation of wall charges on the surface of the valve.

The application of the method to the X-ray spectrometer is now under investigation. Careful screening of the ionisation chamber and leads are necessary in this case, to avoid electromagnetic disturbances.

I am very much indebted to Prof. W. L. Bragg, who has given me every facility for this work.

J. A. C. TEEGAN.

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Jan. 2.

Chemical and Biological Effects of Ultra-Sonic Radiation

ULTRA-SONIC radiation (frequency 723,000/sec.) was produced by means of a quartz plate (35 mm. \times 35 mm. \times 4 mm.).

The effect of this radiation on Ehrlich's carcinoma has been studied by B. Gözsi and found to have no specific effect on this tumour. The chemical action of this radiation has been studied by A. Szalay. The ultra-sonic radiation decomposes cane sugar into mono-saccharides but was found to have no effect on salicyl-phenylester, diphenylether, succinimid, methylal and the benzophenondiphenylacetal of Bruckner. It is not impossible that waves of a higher energy content might attack also such compounds and ultra-sonic radiation might furnish in the end a method for the measurement of the strength of chemical links.

Highly polymerised compounds such as starch, gum arabic and gelatine are easily depolymerised by the radiation employed, as judged by the rapidly falling viscosity. In the case of starch this result was supported by the iodine reaction which changed from blue to the red characteristic for dextrans. Taking into account the very limited effect of the radiation employed on simpler compounds, it seems probable that the observed depolymerisation was not due to the breaking up of chemical links in the stricter sense. It is hoped that ultra-sonic radiation might contribute to the knowledge of the highly polymerised state and to the meaning of molecular weight of highly polymerised substances.

For lack of funds our investigation has been broken off.

A. SZENT-GYÖRGYI.

Institute of Medical Chemistry,
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Jan. 23.

Research Items

Hindu Metal Images. Dr. F. H. Gravely and Mr. T. N. Ramachandran of the Madras Government Museum have compiled an illustrated catalogue of the South Indian Hindu metal images in the Museum collections (Bull., N.S., General Section, vol. 1, pt. 2). The Museum has acquired a particularly fine collection of these images, especially during the last thirty years, mostly from treasure trove. All are religious in purpose and are intended to remind worshippers of the divine. Each must conform to a pattern, laid down by tradition and prescribed in the craftsman's handbook, which is regarded as a canon of divine origin. Hindu sculptors form a special caste. In these metal figures the emblems of the deities, especially the bow, arrow, mace, spear, and flowers that are prescribed to be held in the hands are often inserted separately, the images being cast with the hands in the holding position. Most images have more than one pair of arms. Of the three principal deities, Brahma has four faces and two pairs of hands, of which the upper right holds a rosary and the left a vessel with a spout. Vishnu carries a discus in the right, and a conch in the left of, usually, the upper pair of hands. Siva the destroyer is generally worshipped as a phallus in the central shrine of his temples; but images of him are also worshipped and are taken round in procession at festivals. His usual emblems in southern India are the axe and the antelope, but in the north the trident is more often seen. Other emblems of this deity are the drum, the skull-cap and various weapons of war. He has two aspects, the benign and the terrible. Siva is sometimes shown combined with Vishnu and sometimes with his consort Parvati, as right half male and left half female. By some it is believed that Vishnu cannot function without his sakti, the female principle.

Mexican and Ecuadorian Copper and Bronze Axes. A trial of the relative hardness of different parts of axes of copper and bronze from pre-Columbian Mexico and Ecuador has been made by M. A. Clement (*J. Soc. Américanistes*, Paris, N.S., 24, 1). The specimens examined are in the Musée d'Ethnographie du Trocadéro. Sixteen of the axes were of Ecuadorian origin, four were Mexican. The parts tested were the butt, the middle and the cutting-edge, the object of the investigation being to ascertain whether the last-named by its harder quality pointed to its having received special treatment. Brinell's test for hardness was used with a Bollée machine giving a pressure of 750 kgm. The Ecuadorian axes were all of pure copper with the exception of two which showed very slight traces of tin, and of sulphur respectively. They weighed from 190 gm. to 1,220 gm. The resulting table of coefficients of resistance shows a range of variation: for the butt, 67-112; for the middle, 59-103; for the cutting-edge, 72-121. In seven implements the cutting-edge is harder than the butt; and four are harder in the butt than at the edge. Two are equal in these two parts, but the middle differs; while one is uniform. The Mexican axes weigh from 450 gm. to 1,030 gm., three of them containing 1.8-3.8 per cent of tin. The coefficient of resistance is, for the butt a range of 48-56, for the middle 49-53, for the edge 50-56, the edge being harder than the rest of the implement. It is evident, therefore, that in both the Ecuadorian and the

Mexican axes some process had been employed to render harder the part of the implement to be subjected to shock, and the investigation has produced no evidence against the hypothesis which has been put forward that these pre-Columbian coppers and bronzes were hardened by cold hammering.

Sponges from the North-Western Pacific. Dr. Yaichiro Okada, in his report on the hexactinellid sponges collected by the United States fisheries steamer *Albatross* in the north-western Pacific during the summer of 1906 (*Proc. United States Nat. Mus.*, 81, No. 2935, art. 12, 1932), gives a detailed account of this large and valuable collection of sponges, all from deep water, ranging from 59 to 1,800 fathoms. Altogether there are 42 species and sub-species belonging to 17 genera and 3 sub-genera, 29 species and sub-species being new. This very rich hexactinellid fauna shows a wonderful variety and the live animals must be unusually fine. Unfortunately, they are some of the most difficult of all animals to preserve in anything like their condition in life, although the shape and spicules can be well seen and these serve as diagnostic characters. Naturally, the spicules are very important, and these are well illustrated in clear text figures whilst photographs of the sponges new to science occupy the six plates. Those taken at the greatest depths are *Eurete irregularis* from 1,800 fathoms in brown mud, *Aphrocallistes aleutiana* from 1,046 fathoms dredged with grey mud, sand and pebbles, and *Pheronema surugensis* and *Hyalonema (Coscinonema) ovatum* from 918 fathoms with green mud and fine sand with *Globigerina*. In many cases the external appearance of different specimens of the same sponge are so dissimilar that only very careful examination of the spicules show them to belong to the same species. Thus *Hyalonema (Cycliconema) apertum solidum* new sub-species, has one form tulip-shaped, the other with a transversely expanded body like the fruit of a lotus; *Hyalonema (Cycliconema) hozawai* new species, being tulip-shaped in one form and spindle-shaped in another. In the single specimen of *Farrea sollasi*, there were numerous spindle-shaped larvae in the maternal sponge body which are probably in an early stage of development.

The Genera *Dictyoconoides*, *Lockhartia*, and *Rotalia*. The mislaying of Carter's type specimens led to considerable confusion in the systematic classification of *Conulites (Dictyoconoides)*, Nuttall). With the rediscovery of these specimens, Col. L. M. Davies (*Trans. Roy. Soc. Edin.*, pt. 2, vol. 57, pp. 397-428) has cleared up all previous difficulties. The seven species referred to *Conulites (Dictyoconoides)* are divided into true *Dictyoconoides* with numerous intercalary whorls in their spires and a new genus *Lockhartia* without such whorls. The distinctions between *Dictyoconoides* and *Rotalia* are discussed and emphasised. The systematic part of the paper is followed by an account of the development of the rotalids and dictyoconus group.

Distribution of Irish Plants and Animals. Dr. Lloyd Praeger has reviewed the problem of the distribution of the Irish flora and fauna in "Recent Views Bearing on the Problem of the Irish Flora and Fauna" (*Proc. Roy. Irish Acad.*, vol. 41, sect. B,

No. 8, 1932, pp. 125-145). The author deals with various hypotheses since the time of Edward Forbes, who first discussed the problem of plant and animal distribution in the British Isles, and states that having studied this problem in Ireland for forty years, he still finds himself much where he was at the beginning, a supporter of Forbes's main thesis. Certain plants and animals, including the American and probably the Lusitanian element, survived the main glaciation, these oldest elements having migrated northwards in pre-glacial times or eastwards from America when the intervening barriers of sea were at least much less formidable than they are at present.

Identification of Timbers of *Eucalyptus* Species. Valuable investigation work is being undertaken in many parts of the world with the object of establishing simple methods of identifying timbers. Bulletin No. 67, published under the auspices of the Council for Scientific and Industrial Research, Commonwealth of Australia, comprises Technical Paper No. 5 of the Division of Forest Products and is entitled "Methods for the Identification of the Coloured Woods of the Genus *Eucalyptus*" by H. E. Dadsell and Maisie Burnell. In a foreword, Dr. Boas, chief of the Forest Products Division, states that the macroscopic and microscopic features of some Australian timbers have been studied and keys published for small groups of associated woods. No one had attempted the preparation of a comprehensive key covering any one genus. This work has now been commenced and the bulletin treats of one section of the important genus *Eucalyptus*. The development of methods for the correct identification of the timbers belonging to this genus is discussed. A preliminary separation was made on the basis of the colour of the wood, and two classes, (1) the coloured and (2) the pale coloured woods were arbitrarily formed. The present investigation was confined to the coloured woods, of which some thirty-seven species have been studied. Macroscopic and microscopic examinations were made according to the simpler forms of the usual procedure, the object kept in sight being the preparation of a simple identification key for use for commercial timbers of present and potential value. Such a tentative key is given at the end of the bulletin. The value of simple chemical tests for the separation of species difficult to distinguish by other means is also indicated. Photomicrographs of most of the species are included.

Yangtse-Kiang Flood of 1931. *Matériaux pour les Études des Calamités* (No. 28, pp. 338-351; 1932) contains an account of these great floods by L. Brandt, a member of the Flood Relief Commission in China. Though floods occur every year along the course of the river, especially in the neighbourhood of Hankow, those of 1931 were remarkable owing to their extent and duration. These were due to the unusually heavy rainfall at the end of July, when as much as 5-6 in. fell in one day. At Hankow, the river rose on August 19 to 53.6 ft. above its normal level, and by September 10 had only fallen 2.4 ft. It was estimated that the total area flooded was more than 46,000 square miles, that 45 per cent of the farms in this zone were destroyed, that the length of dams requiring repair was 2,800 miles, and that 10 million inhabitants were driven from their homes. The writer compares these figures with those for the

Mississippi flood of 1927, which covered less than 20,000 square miles and deprived 600,000 persons of their homes.

Temperature of the Stratosphere. Dr. Bruno Rolf has described (*Medd. Stat. Meteorologisk-Hydrografiska Anstalt*, 5, No. 5, Stockholm, 1932), in French, the results obtained from *ballons-sondes* launched from Abisko during the years 1921-29. In this period 156 balloons were launched, and despite the sparseness of population in this far northern region (the latitude of Abisko is 68°), 66 of the balloons were recovered and returned; a reward of 10 Swedish crowns was payable for each balloon restored. Most of them fell in the south-east quadrant from Abisko, the Arctic Ocean being to the north-west. Inquiries as to how the sixty-six discoverers found the balloons elicited forty replies; nine saw the balloon actually descend. Twenty-four were returned within 15 days of launching, 36 within ten weeks, 48 within six months, and 60 within a year; one was not returned until 4 years 7 months after its ascent. The horizontal distances travelled by the balloons ranged from 2 km. to 576 km., the mean being 86 km. In sixty-five cases the traces of the Dines meteorographs carried by the balloons were perfectly readable. Very complete tables of the measurements are given in the memoir, providing data up to 20 km. in several cases. The most interesting and important outcome of the measures is to indicate an unexpected and considerable annual variation of the temperature of the stratosphere at this high latitude; the temperature is greatest in summer and least in winter, the range increasing with height above the tropopause, up to nearly 30° C. at 18 km. This is a phenomenon that may be of capital importance in connexion with the general circulation of the atmosphere.

High Pressure Research. The December 1932 issue of the *Proceedings of the American Academy of Arts and Sciences* contains two papers by Prof. Bridgman of Harvard University on the compressibilities and electrical resistances of materials under great hydrostatic or pneumatic pressure. The compressibilities up to about 1,200 atmospheres at 30° and 75° C. of eighteen sulphides, oxides, nitrates and halides belonging to the cubic system were measured by compressing the materials into cylinders about half an inch long and about the same diameter, which were then subjected to hydrostatic pressure and their change of length measured. The values over the first thousand atmospheres range from 1 to 9 parts in a million per atmosphere and decrease as the pressure increases. For halides they increase from the fluoride to the chloride, bromide and iodide in order, the increase from chloride to bromide being least. The electrical resistances of wires of fifteen metals most of which belong to the cubic system were measured at temperatures 0°, -78° and -183° C. and under pressures up to 7,000 atmospheres of helium. The decrease of resistance in each case is very nearly linear with pressure and at the maximum pressure amounts to about one per cent for columbium, rhodium, molybdenum, tantalum and tungsten, nearly 1.5 per cent for copper, nickel, iron, palladium and platinum, 2 per cent for gold, 3 per cent for aluminium and 9 per cent for lead, at 0° C., and the values are generally somewhat higher at the lower temperatures.

Oscillating Quartz Crystal as an Accurate Clock. Scheibe and Adelsberger, working at the Reichsanstalt, have developed the oscillating crystal as an accurate clock (*Phys. Z.*, Nov. 1932). The clock differs in some respects from those which have been studied in the United States. The quartz crystal is a thin rod supported at its nodal points in an evacuated tube and kept in a thermostat. It is driven by an oscillating valve at about 60,000 c.p.s. and this frequency is stepped down to 333 c.p.s. and used to drive a synchronous motor. The equipment was operated from mains through rectifiers and buffer batteries. One of the clocks was compared, over six months, with international time signals and the mean variation from the mean daily rate was 0.002 sec. The going of such a clock is too accurate to be checked astronomically over a short period. A second clock was constructed and the instantaneous rates of the clocks were compared from time to time. After an initial period of 'running in' the mean variation of the rates was 0.0003 sec./day. These figures compare very favourably with those of other high-precision clocks.

Calorific Values of Indian Woods. An investigation into the "Calorific Values of some Indian Woods"

from the practical utilisation point of view, has been undertaken by Messrs. S. Krishna and S. Ramaswami at the Forest Research Institute. The results are published in *Forest Bulletin* No. 79 (Govt. of India Press, Calcutta, 1932). For practical purposes, the authors say, qualities other than the heat value have got to be considered. *Pinus longifolia*, for example, has been found to possess an average heat value of 5,015 cal. and *Quercus incana* of 4,600 cal.; but in spite of the difference the oak is preferred to the pine for fuel purposes. The choice of wood for fuel, therefore, does not depend upon its heat value alone; there are other factors of importance such as freedom from smoke, ease and completeness of combustion, rapidity of burning, sparking, etc., which must also be considered in making a selection. Calorific values of 150 species of Indian woods have been determined and the values are expressed on zero moisture and ash-free basis. Values of heartwood and sapwood have been determined separately. In general, although there are exceptions, the heartwood has been found to possess higher calorific value and this is particularly true in species containing resinous and volatile matter. The average heat value of Indian woods (broad leaved) has been found to be 5,016 cal., the value for conifers being about 5,120 cal.

Astronomical Topics

Astronomical Notes for March. Mars and Jupiter reach their most favourable positions for the year, being in opposition on March 1 and March 9 respectively. Neptune is near them, having passed opposition on February 27. No other planets are well placed for observation.

The sun crosses the equator and spring begins at 2 A.M. on March 21.

Two lunar occultations are visible in London; stars of the sixth magnitude disappear at 7.56 p.m. on March 4 and at 11.57 p.m. on March 7.

Mira Ceti is due at maximum early in March, but is too low to see except in the evening twilight. The most conveniently observable minima of Algol occur at 10 p.m. on March 12 and at 7 p.m. on March 15. Those using the B.A.A. Handbook are warned that one day should be subtracted from the dates given there from February 18 until the end of April.

Colour Temperatures of Stars. The observation of colour temperatures of stars has been in progress at Greenwich Observatory for some years, and the results so far obtained have now been issued in a special publication. The 'temperatures' finally deduced from the observations are in reality merely a convenient method of expressing the colours of the stars; and, though intimately related, are not actual temperatures of surface regions. The absolute determination of such colour temperatures by direct comparison with a terrestrial source is extremely tedious. Twenty-five suitable stars were accordingly selected in the first place, carefully compared with one another and with a terrestrial source (acetylene lamp) of known colour temperature, and finally used as standards for comparison with other stars. The actual observations of fresh stars were thus reduced to comparatively simple differential measures with one or more standard stars. The necessary photometric scale was obtained originally by the prism-crossed-by-grating method, but owing to the loss of

time due to increased exposure involved, this was replaced by photographing a scale on the plate in the laboratory after exposure in the telescope. Results are given for 63 stars (including the 25 standard stars), and these are preceded by an introduction describing the theory involved as well as details of the apparatus used and practical methods.

New Comet, 1933 a. Mr. L. Peltier has made his fourth cometary discovery; he found a comet of the eighth magnitude on February 16. The two following observations were made by Dr. W. H. Steavenson at Norwood:

Feb. 17^h19^m41^s 23^h31^m20^s 61°56'52.7"
 18 20 0 28 23 56 55.98 61 51 37.2

These will enable a rough estimate of the position to be made; there is not yet material for an orbit, but it is estimated that the perihelion is past, and that the distances from sun and earth are increasing, so the rate of motion may slow down.

A telegram from the U.A.I. Bureau, Copenhagen, gives the following elements and ephemeris of comet 1933 a (Peltier) computed by Drs. Anderson and Wyse:—

<i>T</i>	1933 February 7.63			
ω	137°	51'	} 1933.0	
Ω	313	0		
<i>i</i>	84	55		
<i>q</i>	0.9980			
Ephemeris for 0 ^h U.T.				
		R.A.		N. Decl.
February 21	0 ^h 52 ^m 40 ^s	60° 36'		
" 25	2 21 40	54 44		
March 1	3 23 16	46 6		
" 5	4 3 36	37 4		

The brightness is diminishing.

Ephemerides of some other comets are given in the B.A.A. Handbook.

Halley's Comet in 1909-11

AN exhaustive discussion of the phenomena of Halley's comet and its envelopes, based on the examination of a large number of photographs taken at the Lick Observatory, at its Chile station, and at Mount Wilson, Johannesburg, Helwan, Kodai-kanal, Cordoba, Yerkes, Tokyo, and Beirut, is given by Nicholas T. Bobrovnikoff in a memoir on "Halley's Comet in its Apparition of 1909-1911"; which appears in Lick Observatory Publications, Part 2. The outward motion of luminous patches in the tail was studied, and the repulsive force deduced, the assumption being made that the hyperbolic orbits of these objects were in the same plane as the orbit of the comet's nucleus. The resultant repulsive force was calculated in 31 cases; in 3 cases it exceeded 1,000 times gravity; in 4 cases it was between 100 and 1,000 times; in 6 cases it was between 50 and 100 times. The two tails of the comet on May 29, 1910, are traced on page 457 of the memoir. That of Bredichin's type I is nearly straight, the indicated repulsive force ranging from 9 to 16; the tail of type II is highly curved, the repulsive force being only 0.1 to 0.2. The presence of this curved tail explained the surprising fact that a tail could be seen in the morning sky for some time after the nucleus and straight tail had become evening objects. On account of the curvature of the tail, the author is doubtful whether the earth passed through any portion of it; in any event only the outlying portions could have been traversed.

A study is made of the curved envelopes that surrounded the comet's head. A parabolic outline has generally been assumed for these, but the author finds, as Bond had done in his study of Donati's comet of 1858, that the catenary gives a better representation; it is suggested that the shape may be accounted for if the different envelopes exert some electrical action on each other.

A description was given by Barnard of the appearance of the nucleus. What was taken with a low power to be the nucleus was seen with greater power to be a dense nebulosity of a bluish colour, with a stellar nucleus, 2" or 3" in diameter. It may be noted that a similar small nucleus was seen with large instruments at the near approach of the comet Pons-Winnecke to the earth in June 1927.

Reasons are given for believing that the activity of emission, responsible for sending out the envelopes and luminous masses in the tail, is not confined to the small nucleus, but extends to some distance from it. Comparison is made between the envelopes in Halley's comet with those of Morehouse's comet of 1908, which were studied by Eddington. In the case of Morehouse the envelopes showed rapid motion, sensible in a few minutes, and the repulsive

forces were several thousand times that of gravitation.

There were a few cases of sudden explosive action in the case of Halley's comet, notably on May 13 (Innes) and May 24 (Barnard), but on the whole the disturbances seem to have been much weaker than in Morehouse's comet.

In 1835 Bessel found evidence of rotation of the nucleus; this phenomenon was therefore looked for, but the fact that jets around the nucleus retained their direction for some days, in one case for a week, makes rotation unlikely. Examination was made whether any of the secondary regions of activity round the nucleus gave evidence of separating from the comet (a phenomenon noted in Biela's comet, in the great 1882 comet, and in Taylor's of 1915). The author thinks that Halley's comet may have been on the verge of disruption, but that this was never quite reached.

An estimate is made of the mass of Halley's comet. The author gives 3×10^{-10} of the earth as a lower limit. This is about the mean of the widely different values given by Orlov, but in neither case is it considered more than a guess. As regards the total brightness of the comet in 1910, Holetschek's results are quoted that the comet has not appreciably declined either in light or in length of tail during the last five apparitions. A very different estimate was reached by many English observers in 1910, but this was due to twilight and the comet's low altitude; in the tropics the tail was described as like a great searchlight beam, 140° long; the great length was due to its nearness to the earth. The length in linear units was difficult to compute, owing to great foreshortening; according to Holetschek's discussion it was about a quarter of an astronomical unit on April 21, two days after perihelion, and increased to nearly a unit at the end of May.

The memoir also discusses the comet's spectrum; the continuous spectrum of the nucleus closely resembled that of the stars of solar type λ Serpentis and α_1 Centauri. There is, however, a more rapid falling off of light at the violet end in the comet's spectrum. In this respect the comet resembles the brighter asteroids; the author considers that it denotes the presence of iron in each case.

The author deserves thanks for this painstaking memoir, which describes in close detail the phenomena exhibited by the comet during the time of greatest brightness. Many beautiful photographs are reproduced, including some spectra, and there are many diagrams. The author commenced the work while he held the Martin Kellogg fellowship at Lick Observatory (1927-1929) and finished it when he was a research fellow in the University of California.

A. C. D. CROMMELIN.

Carbon Dioxide in the Sea

IN the biochemical study of life processes in the sea, an understanding of the rôle of the carbon dioxide system is very desirable. In virtue of the excess base always present, sea water contains not only free dissolved carbon dioxide but also many times as much in combination as carbonates and bicarbonates. The equilibrium existing in this system under naturally occurring conditions is a

complicated one. It may be displaced by photosynthesis, changes in calcium due to vital processes, decay of dead matter, temperature, salinity and pressure. To the geologist also its study is of importance since it controls the formation of calcareous sedimentary rocks.

The commonest line of attack is to determine hydrogen ion concentration and excess base. The

direct determination of carbon dioxide has been a tedious business at best and practically impossible on board ship. For this purpose a portable manometric modification of the Van Slyke apparatus has been introduced by Greenberg, Moberg and Allen,¹ who claim for it the virtues of speed, accuracy and serviceability at sea.

In 1930 a committee, set up by the International Council for the Exploration of the Sea, met at Helsingfors, to go into the whole question of carbon dioxide in the sea. The account of its labours is now to hand.² The experimental work covering most aspects of the equilibrium of interest to the marine investigator, appears to have been carried out with exemplary care. It is backed by a mathematical treatment, based on the activity concept, relating the first and second dissociation constants of carbonic acid to the determinable quantities.

There is now no need to undertake the direct determination of carbon dioxide in sea water. From excess base and hydrogen ion determinations, the concentrations of total and free carbon dioxide and of carbonate and bicarbonate ions may be read off directly from tables. A knowledge of temperature and salinity is also required but determination of these is a routine matter in almost all oceanographical work. Furthermore, over large areas of the ocean, excess base has been found to be proportional to the salinity. When this is the case, a rapid colorimetric determination of hydrogen ion concentration gives the key to the whole carbon dioxide system. The importance of this is great since the solution of marine biochemical problems necessitates the accumulation of a large amount of data often under difficult working conditions.

Owing to the thoroughness of the investigation,

the conclusions and tables are intermingled with a large mass of mathematical reasoning, without perusal of which they cannot be properly understood. In consequence, the present writer fears that the non-mathematical, non-German-speaking biologist may be tempted to pass over one of the most outstanding contributions to oceanography in recent years. It seems a pity that the tables have not been published with an English summary sufficient for the field worker who is prepared to take their derivation on trust.

Accurate use of the tables requires a knowledge of the temperature coefficient of hydrogen ion concentration in sea water and in the buffers used for colorimetric comparison and also of the dissociation constants of the indicators used for sea water work. This subject was studied by Buch some years ago.

Re-solution of calcium in the sea and the formation of limy deposits at great depths is affected by the displacement of hydrogen ion concentration with pressure and the increased solubility of carbon dioxide. This topic, discussed in the report, has been further extended by Buch and Gripenberg in another publication of the International Council.³ The change in hydrogen ion concentration with depth is considerable, particularly with an acid water. The *pH* of a water brought from 10,000 metres to the surface would increase by 0.2-0.3 unit. With increasing depth there is a notable rise in bicarbonate ion, accompanied by a decrease in free carbon dioxide and sometimes of carbonate ion.

L. H. N. C.

¹ *Ind. Eng. Chem., Anal. Edn.*, 4, 309; 1932.

² "Über das Kohlensäuresystem im Meerwasser, Bericht über die Untersuchung einer Arbeitskommission". *Cons. Int., Rapports et Procès-verbaux*, 79, 70; 1932.

³ "Über den Einfluss des Wasserdruckes auf *pH* und das Kohlensäuregleichgewicht in grösseren Meeresstiefen". *J. Conseil*, 7, 233; 1932.

Chilean Insect Parasites for New Zealand

RECENTLY Dr. D. Miller of the Cawthron Institute, Nelson, visited South America for the purpose of studying, among other problems, the influence of the Chilean saw-fly, *Antholcus varinervis*, upon the various species of plants belonging to the genus *Acæna*, the foliage and inflorescences of which are attacked by the larvæ of this insect. Certain species of *Acæna* in New Zealand are important weeds which occupy extensive areas of valuable pasture land, while their burrs reduce the market value of sheep's wool to the extent of some £250,000 annually.

During the researches in Chile, it was noticed that the *Antholcus* larvæ did much more damage to the foliage of the thin-leaved Chilean *Acæna* than to the thick-leaved forms, a feature of considerable value, since the important New Zealand species of the genus are of the former type. One of the difficulties in the utilisation of phytophagous insects for the control of weeds is that there is a danger of the insects extending their food range to plants of economic value; to safeguard this as much as possible involves very careful study. In the case of *Antholcus varinervis*, however, the insect itself overcomes this difficulty in that its larvæ are active throughout the winter months when there are, with the exception of strawberry, no useful rosaceans with available foliage; and in the case of strawberry it has been found that the larvæ will not touch the foliage in the presence of *Acæna*. Dr. Miller success-

fully transported to New Zealand a large consignment of *Antholcus* pre-pupæ packed in soil and carried in cool store (40° F.). In New Zealand the insects have developed and attacked *Acæna* in a very satisfactory manner, and there is every prospect of an outstanding success in the control of the weed.

When dealing with *Antholcus* it was found that certain species of Chilean *Thynnidae* attacked cockchafer larvæ. Just as in many parts of the northern hemisphere, the control of native cockchafers is one of the most outstanding agricultural problems in New Zealand, where the larvæ destroy great areas of pasture as well as various crops the roots of which are attacked, while the beetles, as defoliators, cause extensive destruction to turnip and rape crops. Therefore the importance to New Zealand of the Chilean thynnids was at once recognised and arrangements were made for one of the species to be dispatched to the Dominion; this species, *Elaphroptera dimidiata*, is now being studied at the Cawthron Institute. It is of importance to note that the two parasites, *Antholcus varinervis* and *Elaphroptera dimidiata*, both belong to groups not represented in the New Zealand fauna, and, when established in their new environment, should not be seriously influenced by indigenous entomophagous insects. Further, the New Zealand cockchafer larvæ are remarkably free of parasites, a fact that will benefit the influence of *E. dimidiata* upon these hosts.

In the periodical transport of parasites from Chile,

one of the difficulties to be overcome was the absence of direct shipping, which necessitated the transport of material through the tropics by way of Panama. However, the British Consular Service rendered invaluable assistance and willingly undertook the shipping of consignments from Chile and their transshipment to New Zealand boats at the Panama Canal; this system has worked admirably. The researches in Chile were carried out in collaboration with Bro. Claude Joseph (who had been undertaking researches on behalf of New Zealand for some time), at Temuco and in the surrounding Araucanian territory. Bro. Joseph has taken a supply of *Elaphroptera dimidiata* to France in the hope that it may prove effective in the control of the European cockchafer (*Melolontha melolontha*).

Correlation of Meteorological Data

IN a recent publication, Sir Gilbert Walker discusses certain meteorological and solar statistical relationships worked out by E. W. Bliss (*Mem. Roy. Met. Soc.*, 4, No. 36). Many years have elapsed since the work of Tesseirenc de Bort and Hildebrandsson showed that there are regions where the changes of certain meteorological elements are correlated with the changes in the same or different meteorological elements in places so far distant that the discovery of the connexion came as a surprise, and seemed to open up prospects of a greatly increased understanding of the workings of the general circulation of the earth's atmosphere. The work has had practical results in seasonal weather forecasting, for example, in the predictions of the character of the Indian monsoon organised by Sir Gilbert Walker, but has thrown very little light on the physics of the general circulation. So far from providing important generalisations such as would simplify the study of world meteorology, it has resulted in an enormous number of statistical relationships from which cause and effect can seldom be disentangled.

Sir Gilbert's present paper is an attempt at arriving at more definite ideas about the relationships of three important groups of action centres which have been called the North Atlantic, the North Pacific and the Southern oscillations. Each oscillation is defined as the algebraic sum of the deviations of meteorological elements at a number of places in or near the area from which it derives its name. For the North Atlantic, the pressure difference between the Azores and Iceland, and consequently the intensity of the 'westerlies' of that ocean, is an important ingredient in the oscillation. Tables of correlation coefficients are given between the values of the oscillations in individual seasons and pressure, temperature and rainfall at places widely distributed throughout the world, and between the oscillations themselves. As sunspots are believed to be related to the energy radiated by the sun, and it is this energy that maintains the general circulation of the earth's atmosphere, coefficients are also given between the figures for sunspot activity and those for the three oscillations.

The tantalising nature of the results obtained in such studies is well illustrated by the existence of a correlation coefficient of +0.84 between the winter and subsequent summer values of the Southern oscillation. This degree of connexion is remarkable for meteorological conditions separated by an interval of half a year, but the result has not so far been explained on any physical basis.

University and Educational Intelligence

CAMBRIDGE.—The Rockefeller Foundation has given £500 to the Molteno Institute of Parasitology for the purchase of instruments and for assistance in connexion with investigations to be carried out by Prof. D. Keilin.

The Goldsmiths' Company has presented £12,500 to increase the endowment of the Goldsmiths' professorship of metallurgy. The original offer of £10,000 has been increased to the larger sum in view of the fall in rates of interest.

The Gordon Wigan prize for chemistry has been awarded to Mr. T. P. Hoar, Sidney Sussex College, for a thesis entitled "On the Mechanism of the Corrosion of Iron and Steel".

THE twelfth annual vacation course in spectroscopy, interferometry, nephelometry and refractometry will be held on March 30–April 5, at the Zoological Institute of the University of Jena. Further particulars and a syllabus of the course can be obtained from Messrs. Carl Zeiss, Ltd., Mortimer House, 37–41, Mortimer Street, London, W.1.

THE Board of Education is prepared to consider applications for full-time studentships from teachers with at least five years' teaching experience, who desire financial assistance to follow courses of advanced study at universities or other institutions at home or abroad. Particulars of the awards and application forms are obtainable from the Board of Education, Whitehall, S.W.1.

THE sixth annual list of holiday courses in Europe has been prepared and recently published by the League of Nations' Institute of Intellectual Co-operation, acting under the recommendation of the Directors of National University Offices. The list is very comprehensive but only includes those courses which are open to foreigners. Such details as are available are given with each course, together with descriptions of certificates, etc., awarded, facilities for travelling and residence, and names of officials to whom to apply for further information. The pamphlet is published in English, French and German. The English edition can be obtained from Messrs. George Allen and Unwin, Ltd., 40 Museum Street, London, W.C.1 (price 2s.).

Calendar of Nature Topics

Spring Wheat

Great Britain expects at least twice the yield per acre of wheat that the great producing areas of the world obtain, and distinctly more than the average yield of France and Germany, because the climate is admirably suited to the production of heavy yields. Only Belgium and Denmark obtain greater returns per acre. High yields in Great Britain are associated with the distributed rainfall and long period of growth obtained by autumn sowing. Spring sowing, on the other hand, is the practice in countries having severe winters and hot summers, while elsewhere the use of quickly maturing varieties is necessary when only a few months of the year are really favourable to the growth of wheat. A short growth period is associated with a low level of yield. In the ordinary

way, spring-sown wheat is rare in England and is only grown because some circumstance has interfered with sowing at the normal time. This spring, however, it is to be expected that more wheat will be drilled than usual. The crop now stands in a relatively favourable position to the other cereals since the price is known in advance. Early maturity is the important quality in a spring wheat and special varieties, usually French, are used. The ordinary autumn wheats are not suitable, but one of them, Little Joss, is exceptional in this respect and has quite a good reputation as a spring wheat. In order to give a return approaching that of the ordinary wheat, the spring sown crop requires every help that a mellow and fertile seed-bed can provide, and if these conditions can be secured in February the better the prospect for the crop.

The Mole's Winter Store of Earthworms

In the middle of last century Edward Jesse, in his "Gleanings of Natural History", first published the story that, during the winter, moles (*Talpa europæa*) form underground chambers in which earthworms are stored, so mutilated that they cannot escape; but the belief seems to be widespread amongst mole-catchers. On the other hand British naturalists have generally thrown doubt upon the story, regarding it, like Barrett-Hamilton, as "a result of imagination rather than an invention", supported by "no trustworthy evidence". But good evidence did exist even when Barrett-Hamilton wrote. In 1886 Fr. Dahl recorded that he had found in a mole's fortress as many as 1,280 earthworms stored up in the nest-cavity and in the adjoining runs, where they were firmly embedded in the mud walls in small groups of about ten in number; and in 1891 Prof. Ritzema Bos recorded that in February he had received about 300 earthworms found in a mole's fortress. In both cases the worms were damaged: Dahl regarded the damage as being due to forced cramming into the wall; Bos described in careful detail that the mole had bitten off from three to five of the foremost segments of each worm; that the wounded fore end had been covered by a new skin, but no other regeneration had taken place, perhaps because the winter temperature had been too low for this vital process.

Experimental Evidence of Storing by Mole

If further testimony to a remarkable habit was necessary, it has been provided by the experiments of Magnus Degerbøl with a mole he kept in captivity for about six months during the winter of 1922-23. When the mole was supplied with more worms than it could eat, and the earth in its box was only a few centimetres deep, it scraped aside the earth in one corner, seized a worm, crammed it into the hole to the accompaniment of a crunching noise, and finally covered it up with earth which it patted into firmness with its snout. Ten worms were thus buried, and when Degerbøl retrieved them he discovered that one or more of the anterior segments had been bitten clean off. When deeper earth was placed in the box so that the mole could make runs below the surface, it carried the worms below, burying 49 large individuals in 40 minutes. When the runs were dug out the worms were found half coiled and embedded in the walls, a thin layer of earth separating each two worms; fourteen had their foremost segments bitten off, a single one had its hind segments nearly bitten off, and 34 were unhurt. This was the only occasion

on which Degerbøl found the anterior end undamaged, and he attributed it to the embarrassment of the mole at the overwhelming supply of worms, a condition of affairs not likely to arise in natural conditions. The mole touched the surface of a worm with its snout before deciding which was the fore end.

The Purpose of the Mole's Store

As to the purpose of these stores, the existence of which can now be accepted, more information is required. The general idea is that they form a reserve of provender laid by to serve when food becomes scarce in hard weather. But Jesse stated that the basins "appear to be formed in the winter and to have the chief supply of worms deposited in them during the spring months", and Dahl found that the stores were greatest after a prolonged frost—periods at which a true winter store would be at a low ebb. May it be that the storing impulse is not seasonal, and that the size of the store after frost depends either upon the ease with which worms are caught in cold weather, as Dahl suggests, or upon the slowness of regeneration of the tip in cold weather, so that the worms cannot escape so quickly, as suggested by Degerbøl? Some mystery still surrounds the mole's stores, but simple field observations which could be carried out now and during the spring ought to solve the problems.

Spring Increase of Planktonic Diatoms

The latter part of February may show the beginning of the spring maximum of planktonic diatoms in the sea. All-important as food for the small floating animals—especially the larvæ of Crustacea, worms, molluscs and echinoderms which hatch out during and after this large outburst—the diatoms every year multiply in huge numbers during the spring, dwindling again later after depletion by the hordes of creatures feeding on them. In some years this diatom maximum may be early, in other years late, but it always occurs between February and April inclusive.

In 1932 the maximum occurred in the English Channel near Plymouth in March. On March 21, at a point several miles outside the Eddystone Lighthouse, the following diatoms in order of abundance were mainly responsible for the large numbers:—*Coscinodiscus granii*, *Bacillaria paradoxa*, *Skeletonema costatum*, *Chaetoceros sociale*, *Coscinodiscus concinnus*, *Thalassiosira gravida*, *Biddulphia regia*, *Biddulphia sinensis*, *Thalassiothrix nitzschoides*. Most of these species are common members of the spring plankton in these regions, but it is unusual to find *Bacillaria paradoxa* so far from the coast in such huge numbers; and the presence of the two *Biddulphia* species at this time of the year in profusion is abnormal, their usual season being late summer, autumn, and the early winter months.

March Winds

The traditional breeziness of March is expressed in numerous proverbs, and in the French Revolutionary Calendar of 1793 the period February 19–March 20 was the month *Ventôse*—"windy". At Kew Observatory the average wind velocity in March is greater than in any other month, though only slightly exceeding that in February and April, but the impression of windiness is probably to a large extent subjective, resulting from a combination of causes. The relative humidity is decreasing rapidly, giving the air a brisk drying quality, and the mud of

February turns to dust, which is stirred by the breeze. The warming of the ground makes the lower air unstable, sometimes forming small dust-whirls. The broken clouds appear to drift rapidly, forming a 'windy sky'. Boisterous weather is not expected to last throughout the month, however, and it is proverbial that "if March comes in like a lion, it will go out like a lamb".

Societies and Academies

LONDON

Royal Society, Feb. 16. P. M. S. BLACKETT and G. OCCHIALINI: Some results of the photography of the tracks of penetrating radiation. About 500 photographs have been taken of these tracks, using an automatic method by which the passage of the particles through two counters causes the expansion to occur. The most striking feature of the results is the extraordinary variety and complexity of the multiple tracks, some of which show more than twenty separate tracks. An analysis of the nature of the particles producing these tracks leads to the conclusion, already put forward tentatively by Anderson (*Science*, Sept. 9, 1932), that some of the tracks are due to particles with a positive charge, but with a mass comparable with that of an electron rather than with that of a proton. These 'positive electrons' seem to be produced during the nuclear collision processes giving rise to the showers. W. E. GARNER and H. R. HAILES: Thermal decomposition and detonation of mercury fulminate. Single crystals of mercury fulminate have been heated in vacuum at temperatures between 100° and 150° C. and a detailed examination made of the decomposition which ensues. In vacuum the thermal decomposition passes into detonation at 105°–115° C. The conditions which govern the inception of detonation have been investigated. The thermal decomposition occurring below the ignition temperature occurs in three stages: (1) a quiescent period during which there is a slight browning of the crystal, the decomposition being mainly superficial; (2) a period of acceleration of the rate of reaction; and (3) a region where the equation of the first order applies. These results have been interpreted as due to the commencement of thermal decomposition in the Smekal cracks of the fulminate crystal and the spread of the reaction to crystallites isolated by the destruction of the cementing material. The critical increment of the thermal reaction is approximately 30 k. cal. C. R. BAILEY and A. B. D. CASSIE: Investigations in the infra-red region of the spectrum. (8) The grating spectrometer previously described has been applied to certain bands in the infra-red spectra of sulphur dioxide, carbon disulphide, and ozone. The upper limit of resolution at which the spectrometer has been used corresponds to a slit width containing some 2 cm.⁻¹. As a consequence, a previously unsuspected *Q* branch has been revealed in one of the sulphur dioxide bands, which makes it certain that this molecule is an isosceles triangle with a vertical angle of 120°. The structure of ozone is briefly discussed, but sufficient evidence is not available for a definite conclusion.

PARIS

Academy of Sciences, Jan. 9 (*C.R.*, 196, 73–143). L. LECORNU: The variable rotation of a solid of revolution. C. MATIGNON and M. SÉON: The action

of steam on hexane. Description of experiments on the reaction between hexane and variable proportions of steam at 1050° C. in the presence of zirconia as catalyst. The main products were hydrogen and carbon dioxide. Similar results were obtained when benzene was substituted for hexane. LUCIEN DANIEL: The modifications of the reserve function in various plants when submitted to intermittent watering. P. DUBREIL: Mixed total intersections in three dimensional space. S. BANACH and S. MAZUR: The linear dimension of functional spaces. J. SCHAUDER: Linear partial differential equations of the elliptic type. CAIUS JACOB: A mixed problem in the circular ring. J. COLOMB: The Amsler planimeter. Corrections and additions to work on the same subject by Resal. POL RAVIGNEAUX: A new apparatus for calculation with slide rules. G. P. ARCAÿ: The influence of vibrations on the rate of chronometers. CONSTANTIN WORONETZ: The influence of temperature on the stability of gyratory movements of fluids. J. DUFAY: The brightness of the extragalactic nebulae and the absorption of light in the Milky Way. S. SOBOLEFF: A problem of the diffraction of waves. R. DE MALLEMANN and P. GABIANO: The magnetic rotatory power of chlorine and of hydrochloric acid gas. The atomic rotation of chlorine gas is about ten per cent higher than that found in the vapours of chlorine compounds: the value for hydrogen chloride is five per cent higher than the sum of the atomic rotations of its constituents. NY TSI-ZE and CHIEN LING-CHAO: The influence of pressure on the photographic sensibility to various monochromatic radiations. The influence of pressure on the photographic sensibility varies greatly with the wave-length and decreases as the wave-length decreases. MLLÉ. SUZANNE VEIL: The rhythm of crystallisation caused by the diffusion of alkaline carbonates in gelatine. E. CARRIÈRE and MLLÉ. CARLINI: The decomposition of thiosulphuric acid in dilute solution at the boiling point. The products of decomposition were sulphur dioxide, sulphur, sulphuric and pentathionic acids. MLLÉ. A. PINGUET: Oxyallantoin. PARISELLE and BARBIER: Contribution to the study of the cadmium tartrates. P. CARRÉ and D. LIBERMANN: α -Phenyl- γ -oxybutyric acid and its lactone. WIEMANN: The synthesis of vinylpropenyglycol. MME. RAMART-LUCAS and MLLÉ. WOHL: The colour and structure of amides. The study of the absorption of substituted amides leads to the conclusion that an amide, in the liquid or dissolved state, is a mixture of two isomers in equilibrium, amide and iminoalcohol. MME. BRUZAU: The spontaneous resolution into active isomers of 4-methoxy-methyl-desoxybenzoin, C₆H₅.CH(CH₃).CO.C₆H₄.OCH₃. F. ROMAN and M. GAUTIER: The presence of a Bathonian pyritic level in the region of Rar-el-Maden, near Nemours (Oran). IDRAC: An apparatus capable of measuring and recording vertical submarine and sublacustral currents. J. DUCHÉ: Obtaining clones with fixed properties in the Actinomyces. J. MLLÉOT: The systematic position of the spiders of the genus *Liphistius* according to their internal anatomy. RAYMOND-HAMET: The variability of the effects of sparteine on the intestine in situ. PHILIPPE FABRE and PIERRE FAIDHERBE: The constancy of the limiting slope, inverse variations of the chronaxy and of the linear constant in the course of electrotonus of the nerves. Z. M. BACQ and V. HENRI: A spectroscopic proof of the formation of substances by the stimulation of the cardiac nerves. G. SANDULESCO, WANG WEN TCHUNG and A. GIRARD: Contribution

to the knowledge of female sexual hormones. The picrates and styphnates of the crystallised hormones equilenine and folliculine were prepared, and found to be of service in purifying and separating these hormones.

SYDNEY

Linnean Society of New South Wales, Oct. 26. GLADYS CAREY and LILIAN FRASER: The embryology and seedling development of *Aegiceras majus*, Gaertn. This mangrove is characterised by vivipary. After fertilisation the embryo sac enlarges, first by resorption of the nucellus and later by penetration into the micropyle. The cells of the integument in the region of the micropyle, being meristematic, keep pace (by their division) with the advancing sac so that the sac does not at any time emerge from the micropyle. At the same time numerous endosperm nuclei are formed which later give rise to an endospermic tissue in the much enlarged sac. The cells of the integument divide rapidly, and so folds are formed around the embryo sac. The fruit is shed from the tree and under favourable conditions the embryo becomes established in the soil. C. DEANE: New species of Corylophidæ (Coleoptera). Descriptions of new Australian species of Corylophidæ (Coleoptera) under two genera, one of which is submitted as new. Two other genera, not previously figured, are illustrated. IDA A. BROWN: Late Middle Devonian diastrophism in south-eastern Australia. During this period, the meridional geosyncline of earlier Palæozoic times was finally closed up and the south-eastern portion of Australia was permanently welded on to the continental massif. This period of diastrophism appears to be equivalent to the Brunswickian or Arcadian revolution of eastern North America and to the disturbance represented by the unconformity between Lower or Middle and Upper Old Red Sandstone of northern Britain. It may be regarded as one of the major orogenic epochs of the Palæozoic era.

VIENNA

Academy of Sciences, Oct. 27. R. WEGSCHEIDER: (1). Further contributions to photochemical kinetics. Formulae are derived for the course of photochemical reactions from the light-absorption of all the substances present. (2) Photochemical transformation of *o*-nitrobenzaldehyde (ii). The available data concerning this change in the light may be interpreted by assuming a partial inactivation of the molecules affected by light. ADOLF FRANKE, ALFRED KROUPA and SOLON HADZIDIMITRIU: A synthesis of α -alkyladipic acids. A general method of synthesis is applied to the preparation of α -*n*-hexyl- and α -*n*-octyl-adipic acids. The acids obtained are identical with those which were prepared earlier from oxydodecane and were inaccurately described as α -*n*-amyl- and α -*n*-heptylpimelic acids. LUDWIG OTTO KOBLMULLER and RUDOLF VIERTHALER: An arrangement for transferring single-cell cultures to solid nutrient media. Use is made of an adjustable arm carrying a nickel wire pointed to a thickness of 1 micron by treatment with a nitrite solution. FRANZ WERNER and RICHARD EBNER: Results of a zoological expedition to Morocco (1930): (5) Scorpions. The scorpion fauna of Morocco has been revised and a new species, *Buthus barbourni*, and a new sub-species, *Scorpio maurus legionis*, added. FRANZ WERNER: A new snake from the Cyclades Islands. This new species, *Elaphe rechingeri*, is allied to *E. longissima*, which occurs rarely and only in the

extreme west of the Greek mainland. HERMANN TERTSCH: Results of cleavage measurements of galena.

Nov. 3. KARL PRZIBRAM: Recrystallisation and blue rock-salt. (1) The rarity of the blue salt is attributed to the fact that its formation requires in addition to the actions of radiation and pressure, also a low re-crystallising power, this being occasioned by the presence of impurities. (2) Observations on natural blue rock-salt. (3) Further representations of this salt show the formation of diffusion regions, the arrangement of the colour in growth zones and along slip surfaces, and the connexion between the blue coloration and the presence of sylvine. FRANZ KAHLER: Geology of the Karawanken Mountains. FRANZ HERITSCH: The northern boundaries of the Carinthian Alps. FRANZ KAHLER: The Rattendorf Alm and the Nassfeld region. FRANZ KAHLER and FRANZ HERITSCH: The stratigraphic arrangement of the Nassfeld strata. KARL METZ: (1) A fauna from the Hochwipfel strata of the Carinthian Alps. Together with forms capable of only general definition, the following were identified: *Schellwieniella crenistria* Phill.; *Retzia (Hustedia) radialis* Phill.; *Spirifer trigonalis* Mart.; several *Rhombopora* species, comparable with American forms; *Chainodictyum laxum* Foerste; *Chainodictyum laxum* var. *minor* Ulrich, and a new *Septospora* (?). (2) Details of the Nassfeld strata from Schulterkofel westwards. HELMO HERITSCH: Geology of the crystalline zone of the Gail valley. WALTER PASSER: A static process for the calculation of networks of lines.

Nov. 10. G. GORBACH and A. SCHONBECK: Influence of hydrocyanic acid on bacterial proteases. In certain cases, hydrocyanic acid enhances the degradation of the proteins of culture media by *Bacillus pyocyaneus*. ERICH NIEDERDORFER: Measurements of the heat interchange over snow-covered soils. MARIETTA BLAU and HERTHA WAMBACHER: Experiments on the photographic detection of protons liberated by neutrons (2). These protons may be readily detected by using Imperial process plates previously desensitised by treatment with pinakryptol-yellow. The greatest lengths of path thus observed indicate, for the neutron energies, considerably higher values than have been formerly assumed. FRITZ SOCHTING: Vibration amplitudes in resonance. ARTHUR HAAS: Possibility of a cosmological interpretation of the quantum. FRANZ HERITSCH: The Carinthian Alps (1 and 2). ERICH HABERFELNER: Geological survey between Plöckenpass and Hochwipfel. HANS SEELMEIER: Graptolites from the Gugel (district of Stranigeralm).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 633-676, Nov. 15, 1932). A EMERSON WARREN: Xanthophores in *Fundulus*, with special consideration of their 'expanded' and 'contracted' phases. Isolated scales in Ringer's solution released cells which included xanthophores in various states, all of which showed distinct cell outlines, while some had extended processes. Normal freshly fixed material from fish adapted to yellow and to black backgrounds showed cells with nuclei, containing sulphur yellow and orange carotinoids and also reddish granules; in contraction the latter were not always drawn towards the central body of pigment. It is concluded that xanthophores,

like melanophores, are of relatively fixed and constant form. WILLIAM ROWAN: Experiments in bird migration. (3) The effects of artificial light, castration and certain extracts on the autumn movements of the American crow (*Corvus brachyrhynchos*). The normal southward autumnal migration was reversed, to some extent, after increasing artificially the length of the day for five weeks during October–November 1931. Castrated birds went southwards. A non-migratory group was produced by treating caponised birds with injections of an extract from male human urine. All birds migrating maintained the north-west–south-east line of flight characteristic of Alberta crows, although liberated at a non-migratory season. Maps showing distribution of recovered birds and records of observations are given. FRANK H. CLARK: Hydrocephalus, a hereditary character in the house mouse. This lethal character is transmitted as a simple recessive unit character, and it may be linked with the gene producing a flexed tail. M. DEMEREC: Rate of instability of miniature-3 gamma gene of *Drosophila virilis* in the males in the homozygous and in the heterozygous females. W. M. DAVIS: Glacial epochs of the Santa Monica Mountains, California. A new coastal road has provided exposures indicating that the region has suffered three periods of sea abrasion at different levels, with which alternated two epochs of withdrawal of the sea and platform emergence. These withdrawals are believed to mark the beginning of two glacial epochs, but there is no evidence of glaciation in the Santa Monica Mountains themselves, which are too low for such records. G. A. MILLER: The commutator subgroup of a group generated by two operators. L. A. MACCOLL: On the distributions of the zeros of certain analytic functions. MAURICE FRÉCHET: On the behaviour of the n th iterate of a Fredholm kernel as n becomes infinite. NEAL H. MCCOY: On the function in quantum mechanics which corresponds to a given function in classical mechanics.

Forthcoming Events

Monday, Feb. 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Sir Douglas Mawson: The Banzare Film (illustrating the recent voyage of the *Discovery*).

Tuesday, Feb. 28

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major G. St. John Orde Browne: "Economic Development in Tropical Africa as affected by Labour Supply".

Wednesday, March 1

BEDFORD COLLEGE, LONDON, at 5.15.—"Contemporary Developments in Science". Sir Henry Dale: "Ultra-microscopic Organisms and the Troubles which they Cause".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. E. Richardson: "Library Design".

SOCIETY OF PUBLIC ANALYSTS, at 8.—(at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Annual General Meeting.

Thursday, March 2

ROYAL INSTITUTION, at 5.15.—A. R. Hinks: "Geography in the Public Service".

INSTITUTION OF CIVIL ENGINEERS, at 6.—(Extra Meeting).—V. J. P. de Blocq van Kuffeler: "The Zuider Zee Works".

Friday, March 3

BEDSON CLUB, at 6.30.—(in the Chemistry Theatre, Armstrong Colledge, Newcastle-upon-Tyne).—Prof. R. Whytlaw-Gray: "The Accurate Determination of Atomic Weights by the Method of Limiting Densities". PHYSICAL AND CHEMICAL SOCIETIES OF THE UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE, at 7.—Prof. W. A. Bone: "Britain's Coal Problems". GEOLOGISTS' ASSOCIATION, at 7.30.—(in the Architectural Theatre, University Colledge, Gower Street, W.C.1).—Annual General Meeting. A. L. Leach (Presidential Address): "The Geology and Scenery of the South Pembrokeshire Coast". ROYAL INSTITUTION, at 9.—Sir Douglas Mawson: "The New Polar Province".

Official Publications Received

GREAT BRITAIN AND IRELAND

King Edward's Hospital Fund for London. Provision for the Professional and Middle Classes at Voluntary Hospitals in London. Pp. 20. (London: George Barber and Son, Ltd.) 3d.

The British Electrical and Allied Industries Research Association (Incorporated). Twelfth Annual Report, October 1, 1931, to September 30, 1932. Pp. 94. (London.)

Proceedings of the Royal Society. Series A, Vol. 139, No. A838, February 1. Pp. 237–474. (London: Harrison and Sons, Ltd.) 12s.

Proceedings of the Prehistoric Society of East Anglia for 1932. Vol. 7, Part 1. Pp. v+148+17 plates. (London: H. K. Lewis and Co., Ltd.) 15s. net.

The Carnegie Trust for the Universities of Scotland. Thirty-first Annual Report (for the Year 1931–32) submitted by the Executive Committee to the Trustees on February 8, 1933. Pp. iv+86. (Edinburgh.)

Empire Cotton Growing Corporation. Reports received from Experiment Stations, 1931–1932. Pp. ix+172. (London.) 2s. 6d.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 58, Part 1, February. Pp. 234+ix+xvi+60 plates. 7s. 6d. Report for the Year 1932, with Statement of Accounts; Arrangements for the Year 1933; List of New Fellows, etc. Pp. 174+xlvi. 1s. (London: Royal Horticultural Society.)

OTHER COUNTRIES

Scientific Papers of the Institute of Physical and Chemical Research. No. 402: Über die Synthese einiger Methoxymethyl-alkyl-ketone und ihre Beziehung zum Aroma der Gärungsprodukte. By Suttekiti Maruyama. Pp. 53–62. (Tokyo: Iwanami Shoten.) 15 sen.

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 10. Pp. iv+138. (Paris: Les Presses universitaires de France.)

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1931–32. Pp. 45. (Madras: Government Press.) 1.2 rupees.

Ward Memorial Publication, 1931: Physics and Physiology of the Acoustics of Buildings, particularly of the United Provinces Council Chamber, Lucknow. Being University Extension Lecture delivered on December 13, 1930, by Satyendra Ray at the Physics Lecture Theatre, University of Lucknow. Pp. 29. (Lucknow: Ward Memorial Committee.) 1 rupee; 1 dollar.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 68 (Radio Research Board Report No. 5): Atmospherics in Australia, I. By G. H. Munro and Dr. L. G. H. Huxley. Pp. 49. (Melbourne: H. J. Green.)

Journal of the Indian Institute of Science. Vol. 15A, Part 7: Studies in Indian Essential Oils; 1: Essential Oil from Leaves of *Litsea Zeylanica*, Linn., by B. Sanjiva Rao; 2: Essential Oil from Flower-heads and Stalks of *Andropogon Kuntzeanus*, Hack, *Var. Foveolata*, Hack, by B. Sanjiva Rao; 3: Essential Oil from Leaves of *Thymus Serrifolium*, Linn., by Jagjit Singh and B. Sanjiva Rao; 4: Essential Oil from Leaves of *Cinnamomum Zeylanicum*, Brevh., by the late V. P. Shintre and B. Sanjiva Rao. Pp. 71–87. (Bangalore: Indian Institute of Science.) 1 rupee.

Investigations on the Spike-Disease of Sandal. 6: Report of Progress made during the Half-Year ending September 30, 1932. Edited by M. Sreenivasaya. Pp. 17. (Bangalore: Indian Institute of Science.)

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending December 31, 1931, together with the Twenty-fifth Annual Report of the Central Committee of the Association for the Year ending March 31, 1932. Pp. 69. (Madras: Madras Publishing House.)

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 10: An Examination of the Geology and Soils of an Area in the State of Perak. By H. E. F. Savage and R. G. H. Wilshaw. Pp. ii+16+5 plates. (Kuala Lumpur.) 50 cents.

Memoirs of the Punjab Irrigation Research Laboratory. Vol. 3, No. 1: An Analysis of the Utilization of Irrigation-Water in Typical Punjab Canals. By B. H. Wildon and Mehta Mukand Lal. Pp. 10+8 plates. (Lahore.) 8 annas; 9d.

Straits Settlements. Annual Report of the Director of Gardens for the Year 1931. By R. E. Holtum. Pp. 10. (Singapore.)

Proceedings of the American Philosophical Society. Vol. 71, No. 7. Pp. xx+411–427. (Philadelphia.)