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A National Academy of Sciences for India

ALMOST a year ago (October 8, 1932) an account was given in these columns of the foundation in India of the Academy of Sciences of the United Provinces, with its seat at Allahabad. The main objects of the Academy, of which Prof. M. N. Saha was the first president, are the encouragement of scientific work and the publication of the results of research; and the original memoirs published in the issues of the *Bulletin* of the Academy represent a high standard of achievement. To limit interest in such an organisation to the United Provinces is scarcely characteristic of the scientific spirit; and we are glad, therefore, to see a movement to extend its outlook. It is hoped to develop the body into an Indian Academy of Sciences and thus to establish a national institution in the maintenance and growth of which scientific workers throughout India would take an active part.

As a matter of fact, when a number of men of science from different parts of India assembled at Allahabad in January 1930, the question of the establishment of an Academy of Sciences in India was thoroughly discussed. It was then decided to start, as an experimental measure, the U.P. Academy of Sciences, which would be the official expositor of research work conducted mainly in the five universities of the United Provinces of Agra and Oudh, and it was also settled that membership would be open to men of science residing outside the territorial limits of the United Provinces. It was also suggested that if the experiment proved successful, the U.P. Academy might later on develop into an All-India organisation. The progress of the Academy for the last three years has shown that the experiment has been very successful; and members of the Academy residing in other parts of India have suggested that it should become an All-India Academy of Sciences. The U.P. Academy is the first of its kind to have been started in India, and it has, therefore, strong claim to develop into an All-India Academy. We understand that the Council of the Academy has discussed the question recently and has recommended to the general body of the Academy that its name be changed to the 'Indian Academy of Sciences'.

The formation of an Indian Academy of Sciences was advocated in a leading article in *Current Science* in May last. Cogent reasons were then advanced for the establishment of such a body,

the main being the beneficial effect it would have on public opinion, and the facilities which it would afford for the publication in India of much original work which at present appears in European and American journals. The *Indian Journal of Physics* and the *Journal of the Indian Chemical Society* already afford means of publication of papers in their respective departments of science, and take a high place among periodicals of a like kind. They are, however, limited to their own particular fields, and there are other important branches of science for which no similar provision for publication of results of research exists in India. If a national Academy can be established, therefore, to represent scientific work in all departments and publish memoirs from investigators throughout the whole sub-continent, it will undoubtedly render most valuable service.

Several difficulties will have to be overcome, and much consideration will have to be given to the need for co-operation between workers in different parts of India, before an Academy of this kind can be placed upon a substantial footing. India has already the ancient Asiatic Society of Bengal, which was founded to inquire into the history, civil and natural, the antiquities, laws, arts, sciences and literature of Asia. There are few activities in the scientific life of India which have not been linked with this Society, from the early ethnological survey of Col. Dalton and the grand series of papers on the fossil mammalian fauna of the Sub-Himalayas to the foundation of the Indian Museum and its offshoot the Zoological Survey. It may, therefore, be reasonably urged that as the Asiatic Society is not merely a Bengal society but rather an All-India institution, it might be made the nucleus of the suggested national Academy of Sciences.

While, however, we have the highest respect for the Asiatic Society, and are gratefully aware of the mass influence of this ancient foundation upon the advancement of knowledge in India, we do not believe that a society of its comprehensive type is likely to be successfully developed in India or anywhere else in these times. However deplorable the limitations of interest may be, the fact remains that few national societies to-day can deal effectively with a programme of subjects which includes art, history, literature and archæology in addition to anthropology, mathematics and the natural sciences. Such an extended range of interest was appropriate enough when the Asiatic Society was founded, but no society on these lines could now hope for active support from research workers in all these varied fields of investigation.

The formation of the U.P. Academy of Sciences represented the modern tendency to limit the scope of such societies to that of the natural sciences; and the inclusion of other subjects would change its character as well as take away the chief reason for its existence. There might, of course, be half a dozen similar academies of science in other parts of India, but a far better plan would be to concentrate upon a single national organisation with a membership representing scientific investigators throughout the whole country. Difficulties of distance ought not to prevent the successful maintenance of such an academy, when it is remembered that the United States, with a much larger territory, has its National Academy of Sciences as the main centre of publication of scientific papers in the country. The greatest need in India from the point of view of international science is that the leading scientific workers in the country should combine to form a national body which would take its place among other national scientific societies of the world and be the centre of publication of important papers.

If a centralised system of publication in India through a national Academy could be established, a much better idea would be given, than can now be obtained, of the magnitude of the scientific research work being done in the country. At present the tendency is for some of the leading and better known scientific investigators to send their papers to Europe or America in preference to publishing them in their own country, and it would certainly be an advantage to India to have the full credit of such work.

Though there are several important scientific organisations in addition to the U.P. Academy of Sciences, as, for example, the Indian Association for the Cultivation of Science and the Muslim Association for the Advancement of Science, there is no society or academy in India that can claim to represent authoritative scientific opinion in the sense that the Royal Society, or similar national societies elsewhere, is regarded. The Indian Science Congress fulfils very useful functions, but, like the British Association, it is a peripatetic body and is only in session once a year. The success of the Congress does suggest, however, that scientific men in India have interests in common and would be prepared to take part in the formation of a permanent national body to

which the promotion of the scientific credit of the country might safely be entrusted. It is to be hoped that pride in provincial institutions and achievements will not stand in the way of the unity of action necessary to found such a national Academy of Sciences for India, which ought to be able to secure generous financial support from private benefactors as well as from official sources.

Emotion as a Cause of Evolution

The Meaning of Animal Colour and Adornment: being a New Explanation of the Colours, Adornments and Courtships of Animals, their Songs, Moults, Extravagant Weapons, the Differences between their Sexes, the Manner of Formation of their Geographical Varieties and other Allied Problems. By Major R. W. G. Hingston. Pp. 411. (London: Edward Arnold and Co., 1933.) 18*s*. net.

THE conception which forms the foundation of this interesting volume—a conception which, as the author maintains, "contradicts Sexual Selection and modifies the theory of Natural Selection"—assumes that the two antagonistic principles of fear and anger, finding their expression in concealing and brilliant appearances, respectively, are inherent in animal life itself and that their interplay is the determining cause of evolution. This theory encounters at the outset a difficulty like that urged against Wallace's interpretation of the bright colours and striking features displayed in courtship as caused by energy and superabundant vitality. For why should anger any more than vitality find its expression in colours, some of which are due to the selective absorption of light by pigments, while others are due to interference of light by plates of a certain mathematically exact thickness? Is it a probable theory which would attribute to a single fundamental cause the precise chemical constitution of the pigments and the precise thickness of the plates? In support of this theory, the author has brought together and described most attractively a great variety of examples illustrated by numerous simple but very effective figures prepared from his own drawings.

The meaning of bright colours according to the author's theory is clearly set forth in the following passage on pp. 192–193:

"It has sometimes been asked of butterflies, why are they not all concealingly coloured? Bright colours only expose them to danger; would they not much better remain inconspicuous? But in our view, bright colour is supremely important. It is the indication of pugnacity and success, and the machinery for fighting a way through the world. Hence it is more important even than concealing colour. And this agrees with what we find in Nature. For in actual fact concealingly coloured butterflies—and indeed concealingly coloured insects of all kinds—are, in my experience, far rarer than the bright-coloured conspicuous forms. If colour is an adornment, the contrary should hold good, but if colour is a weapon in the battle of life, it is the brightest that should reign supreme."

All naturalists will agree that the bright-coloured, conspicuous insects are more *evident* than the concealingly-coloured species, but few would admit that they are actually commoner. Wallace, with his wide experience of tropical life, considered that the proportion of brilliantly coloured forms was even lower than in temperate latitudes, where it will be generally admitted that the well-concealed are far more abundant than the conspicuous species.

Again, referring to the skunk on p. 34: "Colour display and fluid-discharge . . . do not always go together, and if warning-colour was the whole explanation then the two should always go together, for on that theory the exhibition of colour is nothing but the advertisement of the noxious fluid." But one chief meaning of the warning colours and attitudes of the skunk and of many deadly snakes is to prevent an unnecessary waste of a most valuable defence. As the author says: "An inexperienced puppy will rush on a skunk, and in so doing will learn the lesson of its life. Never again will he repeat the act," and the well-remembered warning appearance will prevent any further loss of skunks' ammunition so far as he is concerned.

It has also been generally agreed that the skunk makes no attempt to escape or to evade possible enemies and it is believed that the frequency with which these animals are killed on the railway tracks is a result of behaviour well known to be even more pronounced in so many conspicuous, distasteful insects which fold their wings, draw in their legs and lie motionless when disturbed. This instinct of 'shamming death' does not in the least suggest an expression of anger or the desire for conflict, but simply a warning of unpalatability, easily seen and, as we know by experiment, well remembered. To call this display a threat instead of a warning does not throw any new light

upon the hypothesis as it was originated by Wallace.

The opinion that the conspicuous hind wings of many moths, shown in flight but hidden under the protectively coloured upper wings when at rest, mean menace and are "especially alarming when suddenly displayed" (p. 195), will scarcely be accepted by those who have witnessed the keen pursuit of the common Yellow Underwing (*Tryphaena pronuba*) by a bird, or have noted the frequency with which the margin of the bright and striking surface is notched. The same criticism holds for the interpretation of eye-spots on butterflies' wings—not indeed all eye-spots, for some of these features in certain positions are probably a defence against enemies, as they are in the terrifying attitudes of many large snake-like caterpillars.

The figures on p. 186 represent an example of the Satyrine butterflies which "have one or two large eye-spots on the under-surface of the front wing. When they alight and close their wings these spots show up vividly, but they have the habit of making the closed fore wings slip down between the closed hind wings just sufficiently far to permit the eye-spots becoming hidden by the hind wings. This is another simple plan of dealing with the colour-conflict," namely, between threatening and concealing colours. But the eye-spots thus displayed for a few seconds are attractive, not threatening. They have been seen to be deliberately seized by an enemy, and it is quite common for the area of the wing on which they are placed to bear the marks of an enemy's attack. Their value is indeed the opposite of that proposed in this work. They are attractive marks, diverting from a vital to a non-vital part the attention of an enemy which has seen the insect as it settles and would immediately deliver an attack, marks that would be a danger if exposed to other enemies hunting over the ground during the period of rest. Against these the safest protection is concealment as complete as possible achieved by the method described and illustrated by the author.

A similar interpretation holds for the eye-spots and 'tails' on the hind wings of the Blues or Lycænid butterflies described as threatening characters on p. 190. Many naturalists have independently recognised in these appearances, with their movements and antenna-like 'tails', combined with the attitude of the insect, the deceptive representation of a head, the real head being at the same time inconspicuous. The elaborate contrivance is not a threat but an adaptation to divert attack from the vital parts, and here too success is proved by the injuries inflicted at this very spot.

It is appropriate, in the concluding paragraphs, to bring forward certain cases—and I select the concordant results of a large number of observations upon insects—which are clearly opposed to the theory of courtship expounded on p. 333 :

"The male behaves in the presence of the female in the same way as before the rival male. He does so because the same anger stirs him, not anger towards the female with whom he expects union, but anger against the rival with whom he has been contending. The rival may not be present, but the burning feeling of hostility is present, and that feeling becomes expressed in the same way as if the rival were actually present. The so-called courtship behaviour is then merely and simply a continuation of hostile behaviour."

It should be borne in mind, in considering the following examples out of a very large body of observations, that the author maintains that his theory applies to insects as well as other animals.

In the courtship of the Small Tortoiseshell butterfly (*Aglais urticæ*), observed by several naturalists, the male pursues the female until, after a time, she comes to rest with widely opened wings. He then settles close behind at such a distance that he can tap her hind wings with the knobs of his antennæ, causing an audible sound. After other flights followed by the same behaviour, the female yields to the stimulus, and darts down into thick herbage where pairing is immediately accomplished. Another instance of butterfly courtship is more consistent with Major Hingston's views—that of the male Wall butterfly (*Pararge megaera*) which butts the female, head to head, and has been seen to treat other males in the same manner. Such 'cave-man' behaviour in courtship and even the milder methods of the Small Tortoiseshell are very rare in butterflies as compared with the delicate persuasion of epigamic odours, referred to below. The males of many species in certain groups bear scent-producing structures on their wings and it is a remarkable fact that their secretions, employed in courting the female, are pleasant to the human senses. In the important group of Danaine butterflies, the scent-scales are collected in patches or withdrawn into pockets on the wings while the odour is transferred for distribution to brushes protruded from the posterior end of the abdomen. The study of the structure and employment of scent organs in butterfly courtship, first undertaken by

Fritz Müller in a series of classical papers (translated by E. A. Elliott and published as an appendix to Dr. G. B. Longstaff's "Butterfly-Hunting in Many Lands" (London)), has been carried on by Dixey, Longstaff, Eltringham, Lamborn, Carpenter and others, who have built up a great body of facts which may be searched in vain for any support to Major Hingston's theory of courtship.

In the attraction of males by some scent emitted by the female there is, of course, competition, but nothing that can be called conflict. In the best-known examples, such as the Oak Eggar and Emperor moths, the general experience seems to be that the first male to arrive is accepted; but there are other instances in which a number of males assemble and flutter round the female—all within a few inches of her—until after some minutes, one of them suddenly flies in and pairs while the others immediately disperse. I have watched this behaviour in beetles as well as moths and there was not the slightest indication of antagonism between the clustering males, or even of their jostling one another.

The conclusions advocated in this volume would, if justified, mean an entirely new theory of evolution in the animal kingdom. Major Hingston would probably hesitate to apply them to plant life. Although it is here maintained that the conclusions are invalid and that no such subversive theory is justified, the reader will be deeply interested by the mass of observations in natural history and will be charmed by the manner in which they are marshalled and described by the author. E. B. P.

World Economic Chaos

World Disorder and Reconstruction: an Epitome of the Economic Situation. By Hubert Blake. Pp. 186. (London: George Allen and Unwin, Ltd., 1932.) 6*s*. net.

MR. BLAKE'S attempt in brief compress to trace the causes of the crisis, to outline the present situation and to assess the conditions and prospects of revival derives its greatest value from the sense of perspective in which it is written. Here is one more writer whose analysis leads him to stress the importance of the effort to persuade governments and peoples to see their present trials not only in their individual incidence but also as part of a great universal disorder, and the grave dangers attending the adoption of merely insular expedients which intensify difficulties beyond their borders. Mr. Blake has resisted any temptation to outline an easy way out of our troubles. He emphasises instead the elementary, if not fragmentary, character of our investigations of monetary phenomena. Much of the statistical knowledge upon which action has to be taken is rather a record of past movements than an accurate reflection of existing tendencies. Nor are authorities everywhere in control of monetary mechanism which can fully reflect their intentions, and it is necessary for stability that all the major control banks should be in continuous and effective co-operation. Effective co-ordination requires the establishment of an international control bank of which the rudiments may be found in the Bank of International Settlements.

Here once again we come to the bed-rock of international co-operation. Progress in monetary technique is at best a slow evolution marked by growth of knowledge and a gradually perfected mechanism, but the growth of international harmony and co-operation permits the readier demonstration of the value of the advances already made to the material well-being of every nation.

Similarly on the industrial side, Mr. Blake points out the subordination of the profit-earning motive to considerations of safety and stability, particularly in the larger organisations, and the dominant influence already exerted on industrial policy and developments by the search for the stability and security which wide fluctuations in the price level constantly disturb. While at the present time the development of such forms of industrial organisation as combines and cartels is immature and accordingly imperfect, they afford a definite means of advance towards co-operation, particularly in the planning of production and the organisation of research. Even in their present imperfect form they are to be preferred to unrestricted and anarchic competition.

Mr. Blake directs attention to certain of the dangers attending industrial combination, particularly the mistaking of financial interlocking for effective rationalisation and co-ordination, the discovery of the first-rate human talent required for their direction and the secrecy in which they operate. On the other hand, the influence of industrial organisation on the improvement of labour conditions, and the magnitude of the contribution of large industrial firms or combines to the scientific study of working conditions, are duly noted. Large-scale industrial undertakings have

in practice encouraged attention to the human interests as much as they pave the way for more conscious direction of industrial effort.

The concluding two chapters of this book deservedly merit the attention of scientific workers from their dispassionate attempt to state the outlines of a constructive solution. The days of unbridled competition and selfish individualism are over. The economist and the banker must seek to provide a more stable standard of value which statesmanship must endeavour to secure against external disturbance, and the industrialist must develop improved means of conducting and extending large-scale organisation. The rise of large-scale industrial units is not contrary to the character or tendencies of British economic and political development and is one of the avenues by which a great increase in the material welfare of all classes may be expected. R. BRIGHTMAN.

Poultry Breeding

Poultry Breeding. By Morley A. Jull. Pp. xiv + 376. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 23*s.* net.

HERE is a book to be studied by every poultry breeder who wishes to carry the best stock and to secure the maximum benefit from his labour. But it is still more valuable to the naturalist and eugenist, for it is an intensive study of the kaleidoscopic combinations of the genes which govern the characters of poultry—and it is clear to-day that analogous systems of combinations are behind the characters of man and all organisms.

The individual is the product of the factors of heritage and of the factors of the environment, but, whereas the former are fixed, the latter may fluctuate from generation to generation. Poultry in this respect are most suitable 'people' for study, since, being warm-blooded, they are to a large degree independent of climate, and their environment is mainly a matter of feeding and housing, both of which can easily be standardised. Bateson saw this and was at work on his pens of fowl when Mendel's paper on peas was rediscovered, and he continued his researches, Punnett joining him in 1904. This was fortunate, for these workers sought knowledge for its own sake—and the revolution in the industry to-day is the direct outcome of their researches.

The author of the work under notice is the senior poultry husbandman of the United States Department of Agriculture, and his theme is the experimental study of inheritance in poultry, the setting out and consideration of facts discovered thereby. As he points out, the ideas derived therefrom, and from similar facts relating to other animals, supplant views once held, such as the inheritance of acquired characters, telegony, prepotency and so on. He professedly writes primarily for the breeder, but, as he treats him as an intelligent being, using the modern phraseology, his book is equally valuable to us. Every line of research is reviewed, and a full list of literature added. Chapters on the inheritance of physiological, of linked and of egg-laying characters interest greatly, for they assure us that all features of the essential life processes of an animal are governed by fixed laws.

Yet withal there is plenty of judgment left to the poultry breeder, for he has to select his breeding pens, keeping ever before his mind the necessary combination of egg-laying and table characters. Since neither the author nor Prof. Punnett, who contributes a pleasing foreword, indulge in prophecy arising out of the results put forward, we venture to suggest that a hundred years hence not a single existing breed will be found in our poultry yards; doubtless all the more prominent unit characters that differentiate our breeds will be recognisable, though in strange combinations.

Wireless Communication

(1) *Short Wave Wireless Communication.* By A. W. Ladner and C. R. Stoner. Pp. xii + 348 + 13 plates. (London: Chapman and Hall, Ltd., 1932.) 15*s.* net.

(2) *La propagation des ondes électromagnétiques: exposé des connaissances acquises, synthèses des idées et des théories.* Par Paul Labat. Pp. xii + 445. (Paris: Gauthier-Villars et Cie, 1932.) 80 francs.

(3) *Les radio-communications modernes.* Par Dr. Pierre David. (Actualités scientifiques et industrielles.) Pp. 150. (Paris: J.-B. Baillière et fils, 1932.) 20 francs.

(1) DURING the past decade the technique of short-wave wireless communication has developed from the erratic experimental stage to its practical and reliable application as a necessary service to modern civilisation. A large proportion of long-distance wireless communication, both telegraphic and telephonic, is now carried out on

wave-lengths of less than 100 metres. The utilisation of such waves has rendered necessary considerable further study and investigation in the art of their production, propagation and reception; and the results of our increased knowledge have led to many radical alterations in communication practice.

The stated object of the book by Messrs. Ladner and Stoner is to fill the gap in current technical literature which has been created by this development. The book gives a comprehensive survey of the technical problems encountered in wireless communication on short wave-lengths, and presents a complete and remarkably up-to-date summary of the literature of the subject collected from the more important periodicals in the English language. The production of high-frequency oscillations with modern valves, the modulation of these oscillations with the intelligible signals to be transmitted, and the arrangement and application of aerial systems for concentrating the resulting radiation in the desired direction are among the subjects dealt with in considerable detail, while the important problem of frequency control is given a separate chapter.

The book is well illustrated and the production is good on the whole, although there are one or two places where the composition might have been improved with advantage; a slight lack of co-operation on the part of the authors is also evident in places. As almost the only work of its kind available at the present time, the book will meet a need experienced by those connected with the technical side of short-wave wireless communication, whether in the actual station or in the experimental laboratory.

(2) The second book under review, by M. P. Labat, is a comprehensive treatise on the subject of the propagation of electric waves through the atmosphere. The subject is dealt with analytically in considerable detail and all the physical properties of the air which might affect wave propagation appear to have been studied. The work, which is accompanied by an extensive bibliography, should prove useful to the research physicist interested in the subject rather than to the general student or the communications engineer.

(3) Dr. David's book is intended for the more general reader. It comprises a survey of the modern practice of radio communication, dealing in turn with the propagation of waves, the use of valves, the technical arrangement of transmitting and receiving stations, and the organisation of communication systems.

Short Reviews

Les phénomènes sociaux chez les animaux. Par Prof. François Picard. (Collection Armand Colin: Section de biologie, No. 158.) Pp. 201. (Paris: Armand Colin, 1933.) 10.50 francs.

THE author, after presenting a chapter on the solitary life that some animals prefer for the whole or part of their existence, differentiates the true social groups, brought together by inter-attraction or interdependence, from mere assemblages of animals that have remained together owing to some influence of the environment. The latter in plants are catered for in the long literature on 'associations', and this is deemed so far to have produced little fruit. The zoologist does not escape, for he prints "steriles et interminables catalogues de Cladocères, d'Ostracodes, des Copépodes, bien moins instructifs que des investigations précises sur les conditions de vie optima d'un seul de ces animaux"; but fortunately this phase is passing, the systematist now being encouraged to spend part of his time in studying his specialities in the field. For "association" here it is better to follow the author and use Gauthier's term "biocenosis", the species and members of which have comparable reactions and are not mere assemblages.

Every grouping of animals does not fit in comfortably, but the author gives a fairly rational classification from the simplest to the most complicated types of biocenosis, where the very existence of the animals is dependent on one another as in many cases of commensalism. Insects naturally rather dominate this study, but there is a pleasing consideration of bird and mammal societies, ending with that of man. While usually an index is required, here none is necessary, for the author carries his 'motive' through his little book, the purchase of which we unhesitatingly recommend to all university students of zoology.

The Essentials of School Geometry. By A. B. Mayne. Pp. xiv+408+ix. (London: Macmillan and Co., Ltd., 1933.) 4*s*. 6*d*.

THE title of Mr. Mayne's book is a little misleading, for although the essentials of school geometry (to School Certificate standard) are here, the book might well be called "A Complete School Geometry"; indeed, this completeness is so apparent that it is difficult to imagine an ordinary form working through the book in the time that can usually be devoted to geometry.

The subject is developed on modern lines and the theorems are arranged in the now generally accepted order; considerable importance is rightly

attached to the setting out of theorems, particular attention being paid to references. Many useful notes and hints are given in the text.

From the teacher's point of view the examples in a textbook are of vital importance. Mr. Mayne's book is unusually rich in examples which are arranged in the following order: numerical, easy, more difficult. This arrangement is very helpful, but the number of examples suggests that the teacher will find it necessary to make a judicious selection of the examples which are to be worked by a particular class.

At the end of the book there are seven blank pages which are intended for alternative proofs; these pages would have been more useful if the author had not already given many alternative proofs in the text. In this connexion it would be interesting to know how the normal boy or girl regards alternative proofs in a geometry textbook; do they lead to confusion or to greater conviction?

The book is stoutly and attractively bound, and should withstand the rough usage of four school years. L. C.

Recovery: the Second Effort. By Sir Arthur Salter. Revised and cheaper edition. Pp. xxxv+306. (London: G. Bell and Sons, Ltd., 1933.) 5*s*. net.

THE first edition of this book has already been reviewed in these columns. To the seventh and cheap edition, Sir Arthur Salter contributes a prefatory note, reviewing events from January 1931 until the present time, in which he appraises such efforts at constructive action and wise leadership as have been witnessed on the international stage. American monetary policy, the Lausanne Agreement, the conversion operations in Great Britain and France are examples in point which lead him to a more optimistic view and to regard a period of partial recovery as having set in. In the worsened sphere of commercial policy, the Far Eastern crisis, the Disarmament Conference and the World Economic Conference he sees dangers and opportunities which underline his emphasis on the need for collective and far-sighted action. No scientific worker concerned with the preservation of the rich heritage of Western civilisation can neglect this book or be indifferent to its challenge to support and assist in the formulation of constructive reform in every main sphere of economic activity and in appropriate deliberate and concerted action.

Monograph and Iconograph of Native British Orchidaceæ. By Colonel M. J. Godfery. Pp. xvi+259+66 plates. (Cambridge: At the University Press, 1933.) £7 7*s*. 0*d*. net.

COL. GODFERY'S admirable monograph of British native orchids, in addition to being a most worthy memorial to the late Mrs. Godfery, is a very valuable contribution to British botany. Col. Godfery has produced a masterly account of great scientific and general interest, which is rendered all the more valuable by the excellent reproductions in colour of Mrs. Godfery's beautiful and accurate pictures. The various species and hybrids are fully described and the descriptions and general accounts throughout leave nothing to be desired. In the case of the very rare species, exact localities are wisely not mentioned.

A feature of particular interest is the account given of the fertilisation mechanisms and of the insect visitors, many of which are figured by the side of the orchids they visit. The monograph is a mine of useful information and sound observation. Both the author and the Cambridge University Press are to be congratulated on the excellence of the book and of its coloured and other plates.

The Interpretation of Dreams. By Prof. Sigmund Freud. Authorised translation by Dr. A. A. Brill. Completely revised edition. Pp. 600. (London: George Allen and Unwin, Ltd., 1932.) 18*s*. net.

THE translation of the eighth German edition of Freud's *magnum opus* is in many ways an improvement on the first. There are many small alterations in the actual translation, but the general plan of the work is unaltered. The difference between this edition and previous editions is small. In the bibliography there are very few references of post-War date; so much has been written in the post-War period that we think this might well have been brought right up to date.

It is a question whether the Freudian interpretation of dreams has the significance to-day that it had some years ago. The theories of Jung and Adler, who broke away from the Freudian school, to-day claim an increasing number of supporters. More recently still, Otto Rank has brought the conception of the will back into prominence and has developed theories around it which bid fair to challenge the Freudian views still more and withdraw support.

A Handbook of some South Indian Weeds: containing Complete Descriptions and Short Notes on some of the Common Weeds indigenous and introduced in South India. By C. Tadulingam and G. Venkatanarayana. Pp. viii+356. (Madras: Government Press, 1932.) 4 rupees.

THOUGH there is a considerable literature relating to the weeds of arable land in temperate countries, very little has so far been written regarding the weeds which occur under similar conditions in the tropics. This handbook, which is profusely illustrated, gives a complete description of the common weeds of southern India. Most of these are indigenous; many of them are cosmopolitan in the tropics and others are closely allied to tropical species found elsewhere. Introductory chapters deal with the classification, dissemination and control of weeds and these are followed by descriptions and notes of individual species.

The Activity of Nerve Cells*

By PROF. E. D. ADRIAN, F.R.S.

SINCE the biologist seeks to understand life, he cannot be accused of lack of courage. But he can find out a great deal without approaching too near the central problem. He can find out how the living cell develops and how it behaves; he can follow many of the physical and chemical changes which take place in it, and could follow more if cells were not so inconveniently small. The immediate problems of the physiologist may be still further removed from the problem of life. They may deal, for example, with the mechanics of the vascular system or with the physical chemistry of blood pigments. But most physiologists aim at explaining the working of the body in terms of its constituent cells, and feel that this is a reasonable aim, even though we must take the cell for granted. Is it a reasonable aim when we are dealing with the working of the nervous system?

The nervous system is responsible for the behaviour of the organism as a whole: in fact, it makes the organism. A frog is killed when its brain and spinal cord are destroyed: its heart still beats and its muscles can still be made to contract, all the cells of its body but those of the brain and cord are as fully alive as they were before; but the frog is dead, and has become a bundle of living tissues with nothing to weld them into a living animal. This integrative action of the nervous system, to use Sherrington's classical phrase, we may be able to explain in terms of the reactions of the constituent nerve cells. We can at least discuss the point as physiologists. But the human organism includes a mind as well as a body. It may be best to follow Pawlow and to see how far we can go without bringing in the mind, but if the reactions of our nerve cells are to explain thought as well as action, we must face the prospect of becoming psychologists and metaphysicians as well. Fortunately, we need not yet go to such extremes.

The nervous system, the brain, spinal cord and peripheral nerves, is made up of a large number of living cells which grow, maintain themselves by the metabolism of food-stuffs, and carry out all the complex reactions of living protoplasm. In this there are enough problems for anyone; but we are concerned not with the general properties of living cells but with those special properties which enable the cells of the nervous system to perform their functions. Their function is to make the organism respond rapidly and effectively to changes in its environment, and to achieve this they have developed a specialised structure, and a complex arrangement in the body. They send out long threads of protoplasm which serve for the rapid transmission of signals, and they are linked to one another by elaborate branching connexions in the brain and the spinal cord.

* Presidential address to Section I (Physiology) of the British Association, delivered at Leicester on September 8.

DEVELOPMENT OF THE NERVOUS SYSTEM

The mapping of this network of paths was begun many years ago, and was the first step in the analysis. No progress could have been made without it, and its results are of vital importance to neurology. We are now witnessing a fresh period of interest in the geography of the central nervous system, but the problem is not how the nerve cells and their fibres are arranged, but why they are arranged as they are. R. G. Harrison, in his recent Croonian lecture before the Royal Society, recalled the time when he first cultivated living nerve cells outside the body. That experiment, made twenty-three years ago, marks the new epoch better than any other, for, besides introducing the method of tissue culture, it settled a long and bitter controversy as to the origin of nerve fibres. Nowadays the most elaborate transplantation experiments are carried out by the embryologists on amphibian larvæ. Animals are produced with supernumerary limbs, eyes, noses, and even spinal cords. The growing nervous system is faced with these unusual bodily arrangements, and by studying the changes induced in it we can form some idea of the factors which determine its normal structure.

A review published this summer by Detweiler gives a vivid impression of the plasticity of the developing nervous system in the hands of the experimenter. As a rule it accepts the extra limb or sense organ, links it by nerve fibres to the rest of the organism and may develop more nerve cells to deal with it. The forces which mould the nervous system seem to come partly from within the central mass of nerve cells and partly from the body outside. These forces may be chemical or electrical gradients, and often the nerve fibres seem to grow in particular directions because they cling mechanically to structures already laid down, for example, to the main arteries of the limbs. It is unlikely that a simple formula will be found for such a complex arrangement, but the fact remains that the arrangement can be profoundly modified at the will of the experimenter. Its detail seems to depend not so much on the innate properties of particular cells as on the environment provided by the rest of the organism.

REACTIONS OF THE NEURONES

This new embryological work supports the older in showing that the nervous system is made up of 'neurones', cells with thread-like extensions, and that they are the only active elements in it. These elements are all cast in the same mould, but are shaped differently by the forces of development.

To this we can now add the fact that all neurones seem to do their work in much the same way. The activity which they show is in some respects remarkably simple. It is essentially rhythmic: a series of rapid alternations between the resting and the active state, due probably to rapid breakdown and repair of the surface. This at least is a fair description of the way in which the nerve fibres carry out their function of conducting messages, and we can detect the same kind of pulsating activity in the nerve cells of the brain.

The evidence comes from the analysis of minute electric changes, for cell activity sets up electrical eddies in the surrounding fluid, and these can be measured with a minimum of interference. The clearest results are given by the peripheral nerve fibres which connect the central nervous system to the sense organs and the muscles. The nerve fibres are conveniently arranged in bundles to form the nerve trunks: each fibre is an independent conducting path and there may be a thousand such paths in a fair-sized nerve, but it is not a difficult matter to study what takes place in the single fibre when it conducts a message.

We may begin with an external stimulus acting on a sense organ, a structure which includes the sensitive ending of a nerve fibre as an essential part. The ending is excited by the stimulus, the delicate equilibrium of its surface is upset and the disturbance tends to spread along the fibre. The spreading is an active process: it takes place because the fibre has a store of energy ready to be liberated at a moment's notice, and because the changes which attend its liberation at one point upset the balance at the next point and cause the same activity there. The spread of a flame along a fuse is a well-worn analogy. But the nerve fibre is so constituted that a disturbance at any point is almost immediately cut short. The change spreads along it as a momentary wave—a brief impulse followed inevitably by a brief interval of rest and recovery. If the sense organ remains excited, a second impulse passes up the fibre, and then another and another so long as the stimulus is effective.

The impulses in a given nerve fibre are all alike in magnitude, rate of travel, etc., but the frequency at which they recur depends on the intensity of the stimulus, rising sometimes so high as 300 a second in each fibre, or falling so low as 10. All the nervous messages take this form.

The conducting threads or nerve fibres are exceedingly insensitive to changes in their environment: their endings in the sense organs are exceedingly sensitive. The sole function of the ending is to act as the trigger mechanism for firing off the impulses, and the sole function of the nerve fibre is to carry the message without distortion. Both are specialised parts of the neurone with specialised reactions, but it is important to note that these reactions are not peculiar to the nervous system. Muscle fibres, developed from the mesoderm and specialised for contraction, conduct impulses which seem to differ merely in their time relations from those in nerve fibres, and they can also be made to behave like the sensory endings by treatment with various salt solutions. In sodium chloride, for example, a series of impulses will be set up in a muscle fibre when it is stretched, as they would be in one of the sense organs the sole duty of which is to act as 'stretch receptors'. The muscle fibre makes a poor copy of the nervous mechanism, for it reacts jerkily and is often damaged in the process, but the ground-plan of the mechanism is the same.

Thus in the activities concerned in the rapid conduction and in the setting up of rhythmic trains of impulses, it does not appear that the cells of the nervous system have properties not shared in some degree by other tissues.

So far we have only considered what happens in nerve fibres. We can tap the messages which pass along the wires between the front line and headquarters, but this does not tell us how they are elaborated there. A great deal has been found out already by the analysis of reflexes—that is, by sending in a known combination of signals and finding what signals come out to the muscles; indeed, the great part of Sherrington's work on the spinal reflexes and Pawlow's on the brain has been carried out in this way. The results are so well known, however, that I shall deal here with a recent line of attack of an entirely different kind.

This method relies on the fact that nervous activity, in the central grey matter as in the peripheral nerves, is accompanied by electric changes. They seem to be a reliable index of the underlying activity, and by recording them we come a step nearer to the main problem. The chief difficulty is to interpret the records. In the cerebral cortex, for example, very large electric oscillations are constantly occurring, except in the deepest anæsthesia, but they vary from moment to moment and from place to place, and it is only in the visual cortex that they are under a fair degree of experimental control. Here they can be produced by shining a light in the eye (Fischer, Kornmüller and Tönnies) or stimulating the optic nerve (Bartley and Bishop), and the prospects of analysis are more hopeful.

At the moment, however, the most significant feature of these records from the brain lies in the appearance of the waves. Whenever a group of nerve cells is in action, in the cerebral cortex, the brain stem or the retina, and whether the nerve cells in question belong to a vertebrate, or an insect, the waves are alike in general form. Instead of the abrupt spikes which appear in a record from a nerve fibre when a train of impulses passes down it, we have more gradual potential changes which form a series of waves of smooth contour. In the simpler structures where most of the neurones are acting in unison, the waves may have a regular rhythm (5–90 or more a second), which rises and falls when the stimulus changes in intensity. It is often possible to make out both

the abrupt nerve fibre impulses and the slower nerve cell waves, and to show that they occur together. In the cerebral cortex of an anæsthetised animal there is much more variety and less orderly repetition; the waves usually occur at irregular intervals; they vary in size and duration, and some of them may last for half a second or even longer.

Nerve cell waves may be the wrong name, for they are probably due to the branching dendrites and not to the cell body of the neurone; but there can be no doubt that they represent a characteristic activity of the structures which make up the grey matter. They show that the same kind of rhythmic breakdown and repair of the surface takes place in this part of the neurone as in the nerve fibre, with the important difference that the changes develop and subside much less abruptly. The surface is not specialised for rapid conduction; the forces which restore the resting equilibrium are less powerful and there is more tendency to spontaneous breakdown and to long periods of uninterrupted activity. We know that the activity of the grey matter is far more readily influenced by chemical changes than is that of the nerve fibre with its elaborate fatty sheath and wrappings of connective tissue, and it seems probable that both chemical and electric changes may be concerned in the spread of activity from one neurone to another. How this spread takes place is still uncertain, and it is admittedly the most important problem we have to face.

In spite of this, we can claim to have some of the main outlines of neurone activity. Our nervous system is built up of cells with a specialised structure and reactions, but the reactions are of a type to be found in many other cells. The rhythmic beat of the heart is probably due to surface reactions not far different from those in the group of nerve cells which produce the rhythmic movements of breathing; and the factors, nervous and chemical, which regulate the heart beat are probably much the same as the factors which control the discharge of the neurone. We have a store of energy, replenished constantly by cell metabolism and liberated periodically by surface breakdown. The electrical gradients at the active point cause a spread of the breakdown to other regions, but sooner or later restoring forces come into play, the membranes are healed and the cycle is ready to be repeated. It is a long step from the mechanical precision of an impulse discharge in a nerve fibre to the irregularities of a record from the cerebral cortex, but there are many intermediate cases which will bridge the gap.

The Nervous System as a Whole

So far as the units are concerned, the prospect is encouraging. The difficulties begin when we come to the work of the nervous system as a whole. Many of its reactions are mechanical enough and can be explained in terms of the activity of groups of neurones, but there is much that resists this kind of treatment. It is perhaps encouraging that the difficulties are greatest when the reactions depend on the cerebral cortex, when they involve learning and memory, or, if you prefer it, habit formation and conditioning. They have been clearly stated by Lashley, and most of them can be reduced in the end to a simple formula, the failure of anatomical models of the nervous system. The revolt from the anatomical model has been growing for many years, though it may be doubted whether its sponsors ever believed in it as much as their critics suppose. It gave us diagrams of nerve centres and pathways which were valuable enough when they referred to known anatomical structure, but not when they referred, as they often did, to hypothetical centres and to pathways canalised by use. These too may exist, but they are not the whole explanation of cortical activity.

Clinical neurology is partly to blame for the emphasis laid on exact localisation. The neurologist must locate brain tumours by analysing the disturbances they produce; consequently he welcomes the slightest evidence of localisation of function in the cortex, and finds the anatomical model valuable for correlating his observations. Undoubtedly there are well-defined nervous pathways, clear differences in cell structure and localised activity in different parts of the brain. As a modern addition to the evidence we have Foerster's recent work on the electrical stimulation of the human cortex, and his finding that stimulation of the temporal lobe may cause sounds and words to arise in consciousness, whilst stimulation of the occipital lobe gives lights or images. Bard has given another remarkable example of strict cortical localisation by his observations on certain postural reactions in the cat. These depend on a limited area in the frontal region, are not affected by damage to other parts of the brain, but are permanently lost if the frontal area is destroyed. The danger nowadays is that we may pay too little attention to such facts; but it is true, nevertheless, that the localisation is a matter of areas rather than of single neurones. This is shown by examination of habit formation, and by the remarkable way in which the nervous system adapts itself to injury.

It has often been pointed out that we learn to recognise shapes—the letters of the alphabet, for example—however they are presented to us. The pattern of black and white made on our retina by the letter A need not fall on a particular set of retinal endings connected with particular cortical neurones. We have learnt to recognise a relation of lines and angles, a pattern of activity in the cortex rather than an activity of specific points. This kind of reaction is not due to our superior intelligence. Lashley finds it in the rat, and psychologists of the *Gestalt* school have pointed out examples from all manner of animals. There is the same neglect of specific neurones in the formation of motor habits, for if we have once learnt to write the letter A with our right hand, we can make a fair attempt to write it with any group of muscles which can control a pencil.

The adaptations to injury present a different aspect of the same story. An insect which has lost a leg will at once change its style of walking to make up for the loss. This may involve a complete alteration of the normal method, limbs which were advanced alternately being now advanced simultaneously. The activities of the nervous system are directed to a definite end, the forward movement of the animal—it uses whatever means are at its disposal and is not limited to particular pathways.

When the central nervous system is injured, there is more evidence of localised function, but the localisation is no hard-and-fast affair. A rat uses its occipital cortex in the formation of certain visual habits. When this part of the cortex is destroyed the habit is lost, but it can be re-learnt just as rapidly as before with what remains of the brain. A monkey's arm is paralysed if the corresponding motor area of the cortex is destroyed, but the paralysis soon passes away although there is no regeneration of the motor cortex. What is more remarkable is that the recovered functions are not associated with the development of a new visual region or motor region in the brain. Though they were originally localised, there is no longer any one part of the cortex which is essential.

In reactions where there is no evidence of localisation (for example, the learning of maze habits in the rat), Lashley finds that the important factor is the total mass of the cortex and not the presence of particular regions. The effect of an injury depends on its extent and not on its situation. It depends, too, on the amount of grey matter (nerve cells and dendrites) destroyed, and not on the cutting of connexions between the different parts of the cortex. Thus the ability of the brain to form new associations, and generally to control the behaviour of the animal, depends primarily on the total area covered by the nerve cells of the cortex and their interlacing dendrites. For certain reactions it depends to some extent on the arrangement of pathways, but this arrangement is not essential. There is more localisation of function in the large brain of man than in the very small brain of the rat, for different cortical regions may be completely equivalent when they are separated by 5 mm., but not when they are separated by 100 mm. But apart from this difference in scale, it is likely that the human cortex has the same mass effect and plasticity of function.

How do the individual neurones combine to produce a system which can recognise a triangle or direct the movements of the organism with such disregard of detailed structure ? If particular neurones or pathways are not tuned to triangularity, how can the whole mass be tuned to it, and why should the tuning be more certain when the mass is greater ? Our data may be at fault and the mass effect an illusion, but there is certainly enough evidence for it to be taken seriously. Though there is no solution at the moment, I cannot believe that one will not be found—a solution which need not go outside the conceptions of physiology. It should be possible, for example, to find out how many neurones must be combined to give a system which reacts in this way and what kind of structure they must form. The nervous systems of insects may provide the clue, for these may contain a few thousand nerve cells in place of the ten thousand million in the human brain. It is possible also to study the reactions of isolated parts of the central nervous system, to see how far their behaviour can be explained in terms of the units which compose them. The retina is an interesting example of this kind, for it contains an elaborate structure of nerve cells and dendrite connexions, and has some of the reactions which we might expect from a mosaic of sensory endings, and some which depend on interaction between the different neurones.

Even now, however, we can form some idea of the way in which the grey matter can act as a whole. The electric oscillations in the cortex and in the grey matter generally are often due to a large number of units pulsating in unison. Sometimes there are several competing rhythms, and sometimes the collective action breaks down altogether, to reappear from time to time when some part of the system is stimulated to greater activity. When these collective rhythms appear, the neurones are already acting as though they formed one unit. There is no need to regard the dendrites as forming a continuous network—electric forces may well bridge the gaps between them—but they may form a system in which activity can be transmitted more or less freely in all directions. The patterns of activity in a system of this kind would be like the ripples on the surface of a pond, with the difference that some of the ripples may occur spontaneously, whilst others are due to incoming signals. Interference figures and nodes of vibration may then be all-important. They would at least give a basis for the recognition of relations such as those of triangularity or squareness without the need for an excitation of specific points, and they might be formed with less distortion in a large pond than in a small one.

This does not take us very far : in fact, the major problems of the central nervous system are left in greater obscurity than ever. But no one can observe these ceaseless electrical pulsations without realising that they provide a fresh set of data, and may give a fresh outlook on the working of the brain. The facts are still too uncertain to be worth treating in greater detail. But they accumulate rapidly, and several lines of evidence seem to lead in the same direction. For the present, it is enough to state our problem, that of the organisation of neurones into the nervous system. It is still a physiological problem, and I hope that a solution will be found on physiological lines. If it cannot be found, it will be extremely interesting to see where the breakdown occurs ; and if it can, it will be even more interesting to see what light it throws on the relation of the nervous system to the mind.

How long do Seeds retain their Vitality?

THE idea of seeds germinating after a lapse of many centuries rarely fails to appeal to the imagination. Probably that is why so many inaccurate and fantastic statements have been made regarding this subject, with which Mr. J. H. Turner has recently dealt in an article entitled "The Viability of Seeds" (*Kew Bulletin*, No. 6, 1933. London: H.M. Stationery Office. 1*s*. net). From earliest times people have wondered how long seeds for field and herb garden would keep fresh. Theophrastus, writing about 320 B.C., mentions that "Of seeds some have more vitality than others as to keeping; among the more vigorous ones are coriander, beet, leek, cress, mustard, rocket, savory. . . ." Little was known, however, about the vitality of seeds of wild plants until De Candolle, in 1832, concluded that seeds of many species remained viable in the soil for considerable periods.

"The average life of seeds, as of plants, varies greatly with the different families, genera and species, but there is no relation between the longevity of plants and the viable period of the seeds they bear. Some seeds retain their power of germination for a few days only, such as the willows and poplars, others remain viable for months or even a considerable number of years." The factors which produce a capacity for sustained vitality are still imperfectly understood, but it is known that, under suitable conditions, seeds of 'macrobiotic' families, notably Leguminosæ, Malvaceæ, Myrtaceæ, Nymphæaceæ, etc. may remain viable from fifteen to more than a hundred years.

Only a limited number of cultivated plants produce seeds which retain their vitality for any length of time when buried in the soil, but those of weeds are capable of living for extended periods, and when deeply buried are better preserved as a result of the more equable conditions. The appearance of plants from dormant seeds when ground is freshly turned up is well known, and the prolific growth of poppies, camomile and charlock on the Somme battlefield from latent seeds brought to the surface by shell fire is mentioned. Charlock, *Sinapis arvensis*, appeared on earth thrown up by shells and in shell craters, when there was no trace of it on the undisturbed ground; this may be readily appreciated when we read that seeds of charlock may retain their vitality for forty years when buried in the soil.

Instances of gorse seeds, *Ulex europæus*, which retained their vitality for forty, twenty-five and twenty years in the soil, and seeds of acacia, foxglove, campanula, etc., which grew after being buried for many years are described, but the most interesting account is that of *Nelumbo*, the Japanese lotus or sacred lotus of India. "Probably the record longevity for any seed is that recorded by Ohga who obtained approximately 100 per cent germination with 'seeds' of *Nelumbo nucifera*, Gaertn. which he found on a peat bed buried two feet deep with loess in the Pulantien river valley in Southern Manchuria, the bed being 12½ metres above the present water level of the river. Judging by the age of trees of *Salix babylonica* on the bed of this former lake and from the rate of lowering of the water level, it is probable that the 'seeds' are at least 120 years old and may be 400 years old or even older, judging by the rate of erosion." Ohga gave thirty of the "seeds" to the British Museum, and in 1931, at the request of Sir Arthur Hill, the British Museum authorities sent two of these "seeds", which they had germinated, to Kew. The seedlings were planted in the *Victoria Regia* pool and flowered during August 1932. "Apart from the smaller flowers and seed vessels, there was nothing to distinguish them from *Nelumbo nucifera*, Gaertn. raised from recent 'seed'."

In 1879 Beal mixed seeds with sand and buried them in bottles. The results of this experiment show that after fifty years, seeds of *Brassica*, *Œnothera*, *Polygonum*, *Rumex* and *Verbascum* are capable of germination. Duvel experimented under more natural conditions, mixing the seeds with soil and using earthenware pots covered with porous saucers. It was found that of 107 species, 51 grew after being buried for twenty years. Shull found that seeds of many land and water plants would germinate after immersion in mud and water for periods of four to seven years. Some seeds will even withstand the action of salt water for considerable periods.

Various experiments made over a period of more than a hundred years with seeds stored in museums and herbaria are described by Mr. Turner, including the 150-year old seeds of *Nelumbium* [*Nelumbo*] *speciosum* in the British Museum, which Robert Brown germinated in 1850, Ewart's success with 105-year old seeds of *Goodia lotifolia* in Australia, Becquerel's 87-year old seeds of *Cassia bicapsularis* in the Herbarium of the Natural History Museum of Paris, and Turner's experiments in 1932 with seeds from dated bottles in the Kew museums. *Anthyllis Vulneraria* and *Trifolium striatum*, both 90 years old, gave a germination of 4 and 14·1 per cent respectively. "The seedlings are now growing in one of the houses at Kew." Ewart formed the opinion that "However dry the seeds may be they cannot indefinitely prolong their vitality. Even the most resistant seeds after 50 to 100 years show a pronounced decrease in the percentage germination, and the general trend of the curves is such as to show that the probable extreme duration of vitality for any known seed may be set between 150 and 250 years (*Leguminosæ*)."

Heldreich suggests that the sudden appearance, in the Laurion area (Greece), of *Silene juvenalis* and a supposed new species which he named *Glaucium Serpieri* was due to their seeds having remained buried for more than fifteen hundred years in the soil under the heaps of old mining débris. When the débris was removed, the

seeds sprang into life again. A taxonomic investigation made by Dr. Turrill has shown that *Silene juvenalis* is conspecific with *S. subconica*, a not uncommon species in the countries around the Ægean Sea. There is nothing in the taxonomy or distribution of *S. subconica* and *Glaucium Serpieri*, which has been shown by Turrill to be *G. flavum* var. *leiocarpum*, to make it improbable for them to occur naturally in the Laurion district, and in all probability both species were in the neighbourhood before the heaps of débris were removed, and simply spread on the vacated and denuded ground in the absence of close competition. "The evidence is all against either *Glaucium* or *Silene* at Laurion being examples of long enduring seed dormancy."

In spite of research, popular belief clings tenaciously to the fairy tales concerning the germination of seeds from ancient tombs, which newspapers and broadcasting have unwittingly circulated. Stories of seed germination after a dormancy of thousands of years have even been used as an illustration of immortality. The reply to this curious notion deserves to be quoted in full :—"There is no authenticated evidence that wheat taken from undisturbed Egyptian tombs will germinate. An experiment was made at Kew some thirty years ago with grain from a model granary, found in a tomb of the 19th dynasty and brought to England by Sir E. A. Wallis Budge. Samples were tested under various conditions and the effect of coloured glass was tried in the effort to induce germination, but after three months the grain had turned to dust. Percival states 'I examined a number (of grains) found by Prof. Flinders Petrie in the Græco-Roman cemetery at Hawara (about first century B.C.) . . . the embryo had become dark brown, its plumule greatly shrivelled and little of its structure was visible.' " "In grain from a tomb of the 18th dynasty, 1400 B.C., 'all the parts were more brittle and the embryo more completely disorganised than in the grains from Hawara. It is scarcely necessary to observe that the embryos were dead. Prof. Petrie tested samples of grain of Græco-Roman age which he found at Hawara immediately after exhumation. The grains were sown on the banks of a canal in varying degrees of moisture . . . but none germinated.' " "According to Gain, although Egyptian wheat and barley often have an exterior appearance of good preservation, the embryo has undergone a marked chemical change and is no longer viable. This change shows that the dormant life of the grain has long been extinct."

"Sir E. A. Wallis Budge has accounted for the popular belief in the germination of grain from Egyptian tombs and explains that for hundreds of years the natives of Egypt have used the halls of tombs for the wheat and barley obtained from Syria. Ancient coffins have been packed in this Syrian wheat and sent to England, and such grains will, of course, grow. During the last 30 years the native dragoman and guides have found that tourists will buy 'mummy wheat' and they keep supplies in the tombs, carefully hidden, which they dig up under the eyes of the astonished visitor and offer as 'mummy wheat' or 'mummy barley'."

It is amusing to know that the guides sometimes 'find' grains of maize in Egyptian tombs in order to supply the credulous tourist, forgetting that maize was unknown until the discovery of America, whilst some of their faked wheat samples produce plants suspiciously identical with the improved wheat varieties grown in Egypt at the present time.

"Cereals are ill adapted for a prolonged period of quiescence. Sifton has shown that Canadian wheat may retain its vitality for 18 years, and that the longevity of oats is greater than that of wheat, possibly owing to the protection of the hulls. Nineteen-year old kernels of oats gave a germination of 41 per cent. Percival records an exceptional case of wheat remaining viable for twenty-five years. White found that in Australia the germination of wheat is lost after 11–16 years and that of barley after 8–10. Fanciful tales are current with regard to 'miracle' or 'mummy' wheat, *Triticum turgidum* var. *mirabile* Körn and 'mummy peas', *Pisum sativum* var. *umbellatum* (Mill.) Ser."

It may be of interest to mention here that a branched form of *Triticum turgidum* has been grown for many years in America under the various names of 'Alaska', 'Many Spiked', 'Seven-Headed', 'Multiple-Headed', 'Egyptian', 'Miracle', 'Mummy', 'Wheat 3,000 Years Old', etc. These last four names are derived from an untrue story which tells that when the coffin of an Egyptian mummy was opened, some wheat was found. The seeds were planted, but only a single grain grew. The resulting plant proved a wonderful yielder and very different from any wheat now grown. It seems quite natural that if an unbranched head will yield so much, a branched head should yield much more. Actually the branched heads contain more grains than the unbranched heads of ordinary varieties, but as there are far fewer heads per acre, the yields are naturally less. A branched form of *Triticum turgidum* has been tried in the British Isles, but its general produce does not warrant its cultivation here, for it is inferior both in yield and quality.

"Miracle wheat is the commonest branched form of *Triticum turgidum* met with in South Europe and the North African coast. It is usually cultivated as a curiosity. Fasciated forms of the pea, similar to the so-called mummy pea, are figured by Tabernæmontanus in his Herbal published in 1590, and Miller in his Gardeners' Dictionary, 8th edit., 1771, described the form under the name of *Pisum umbellatum*, rose or crown pea. The misleading name of mummy pea is equally applied to the non-fasciated form, sometimes grown in cottage gardens. It is popularly asserted that miracle wheat and mummy peas originate from Egyptian tombs and that such seeds germinate when sown, but in every instance the statements prove to be without foundation."

Obituary

PROF. WILLIAM G. CRAIB

WE record with deep regret the untimely death of Prof. W. G. Craib, regius professor of botany in the University of Aberdeen, which occurred at Kew, after only a few hours' illness, on September 1 at the age of fifty-one years. He had been spending part of his long vacation at Kew, working in the Herbarium on the Siamese flora, a practice he had regularly followed for many years past.

W. G. Craib was born on March 10, 1882, at Banff, and received his early education at Banff and Fordyce Academies. Though, no doubt, inheriting an interest in plants from his parents, he entered the University of Aberdeen as an arts student, and it was only later that he turned his attention to botany. Unfortunately, or perhaps fortunately as things turned out, he suffered with his eyes in his early undergraduate days and was advised to give up reading for a time. He therefore took service as a ship's engineer until the trouble with his eyes was overcome and then returned to the University and graduated M.A. In his summer vacations, when an undergraduate, he used to go on the Fishery Board's yacht at Aberdeen and trawl for diatoms. The great stimulus which definitely turned his thoughts to botany as a serious study was the winning of the Dickie prize in the University, for a collection of wild plants made around Banff, where the flora is rich and varied.

Craib's enthusiasm and definite interest in systematic botany was naturally fostered by the late Prof. Trail, and when Craib was taking the course of study for the B.Sc. degree, in 1908, Prof. Trail directed his attention to the chance of taking a temporary post as acting curator of the Herbarium at the Royal Botanical Gardens, Calcutta, which Major (now Colonel) Gage was then seeking to fill. Craib at once volunteered for the post and spent a year at Calcutta, much to his own advantage and also to the advantage of Indian botany.

While at Calcutta, under Mr. (now Sir William) Wright Smith, during the time that Major Gage was on leave, Craib made a collection of plants in the North Cachar Hills, which he afterwards named. On the conclusion of his year in India, the assistantship for India at Kew fell vacant, and the post was offered to Craib by the Secretary of State on the recommendation of Sir David Prain, then Director of Kew. During his tenure of this important post he made valuable contributions to the botany of India and south-west China, and wrote an account of the "Chineæ Leguminosæ" in Sargent's "Plantæ Wilsonianæ", vol. 2, 1914; he also gave an account of the species of *Indigofera* in China in *Notes of the Royal Botanic Gardens, Edinburgh*, 8, 1913. He was also interested in Asiatic Gesneraceæ, especially after taking up his studies on the flora of Siam, and contributed papers on this family to the Edinburgh *Notes* in 1918 and 1919.

In 1915, Sir Isaac Bayley Balfour offered Craib the post of lecturer in forest botany and Indian trees in the University of Edinburgh, a post he filled with distinction until he received the appointment to the regius professorship of botany in the University of Aberdeen in March, 1920. While at Edinburgh, he published his well-known papers on "The Regional Spread of Moisture in the Wood of Trees" published in the Edinburgh *Notes*.

In 1917 he married Mary Beatrice, younger daughter of the late Mr. James Turner of Acton.

Craib suffered the severe loss of a leg in an accident during the meeting of the British Association at Edinburgh in 1921, a loss which deprived him of much of his accustomed activity and no doubt adversely affected his health. Despite this great handicap, however, he carried on his work unabated and devoted himself with the greatest assiduity to his systematic work. For many years he had concentrated his attention on the flora of Siam, working out the important collections made by Dr. A. F. G. Kerr, Government botanist in Siam, and other collectors, and the considerable portion of the flora so far completed will remain as a fitting memorial of his life's work. The many new species he described have been published during a long series of years in the *Kew Bulletin*, since much of his Siamese work was carried out at Kew during his long vacations, on Kew material.

By Craib's death, the University of Aberdeen has lost a stimulating teacher, a worthy successor of the late Prof. Trail, who, like Trail, fully recognised the importance of systematic botany as a university study; while his botanical colleagues mourn the loss of a distinguished systematic botanist, who was always a most helpful adviser and kind friend.

A. W. H.

PROF. J. W. HINTON

THE death, on July 15, at the early age of thirty-eight years, of Prof. John Wilkie Hinton, has deprived Ceylon University College of a brilliant scholar and one of its ablest and most esteemed teachers. John Hinton was born in Invercargill, New Zealand, on January 21, 1896, and was educated at Southland High School and the University of Otago. His education was practically dependent on his own efforts, but his brilliance gained for him those scholarships which made it possible. He graduated B.Sc. in 1915, and winning the Beverley scholarship in physics and the advanced science scholarship for New Zealand, he studied advanced electricity and magnetism for his honours degree of M.Sc., which he took two years later. He joined the staff of his College then as demonstrator in physics, and after serving with the New Zealand Expeditionary Force in France, where he was wounded, he

returned to New Zealand to be appointed lecturer in physics at the University of Otago. Throughout his academic career, and on the staff of his College, his influence was such that he was appointed acting master of Knox College during the absences of the late Prof. Hewitson.

During 1925 and 1926 Hinton worked at the Cavendish Laboratories under Lord Rutherford, where he held the appointment of demonstrator in physics.

In 1926 Hinton was appointed professor of physics in the Ceylon University College, one of the youngest of the colonial colleges. The importance of his work in Ceylon can scarcely be overestimated: he was unable to leave any research record, for his time was fully occupied with the organisation and teaching work of his department. He came to an ill-equipped and badly understaffed physics department in a very recently established college. But by continual application and rigid perseverance, he overcame the difficulties to be faced, and not only reorganised but also extended his department, thus bringing it to the high state of efficiency which it has now reached. He was an able and enthusiastic teacher conscientious to a degree in his teaching; he had a remarkable understanding of the difficulties of young students; his influence on their characters both in class and elsewhere was great; and his tact, common-sense and administrative abilities gave him a high place in the esteem of his colleagues. There is not a doubt but that his work in building up his department, and his influence for good on the hundreds of young men who have come under the spell of his charming personality, have set up a tradition which will continue to benefit the Ceylon University College for many years to come. D. R. R. B.

We regret to announce the following deaths:

Mr. F. J. R. Hendy, director of training of teachers in the University of Oxford, on September 4, aged seventy-five years.

Prof. Frank R. van Horn, professor of geology and mineralogy in the Case School of Applied Science, Cleveland, Ohio, director of the Cleveland Museum of Natural History, and secretary of the Mineralogical Society of America, on August 1, aged sixty-one years.

Dr. Herbert Lapworth, president in 1927–28 of the Institution of Water Engineers and secretary of the Geological Society of London from 1914 until 1921, on September 18.

Prof. Leonard J. Rogers, F.R.S., formerly professor of mathematics in the University of Leeds, on September 12, aged seventy-one years.

Lieut.-Col. R. H. Rowe, commissioner of lands, Nigeria, known for his work on the topographical and trigonometrical survey of Nigeria, for which he was awarded the Back grant of the Royal Geographical Society in 1931, on September 6, aged fifty years.

Prof. R. Ramsay Wright, emeritus professor of biology in the University of Toronto, known chiefly for his work on the comparative anatomy of vertebrates, on September 5, aged eighty-three years.

News and Views

De-Rating Research Laboratories

Now that public attention is being given to the desirability of establishing a more effective liaison between science and parliament, the moment is opportune to advocate legislation which would result in the de-rating of research laboratories in the same way that factories were de-rated under the Act of 1928. The case for the de-rating of research laboratories is every whit as strong as that for relieving the factories of the burden of local rates. Industry and research are intertwined; both are productive; and any avoidable burden that retards the progress of research must be calamitous in its incidence. It is remarkable that the industrial research laboratories maintained by individual firms were not relieved in 1928. Normally they are situated in, and form part of, the buildings so relieved then. They are equally productive, and should, logically, receive the same treatment. If this be true of the individual industrial research laboratories, how much more true is it of the laboratories maintained by the industrial research associations, and laboratories maintained by national bodies and educational institutions, particularly the laboratories where fundamental and experimental research is carried out. It is on the research carried out in such laboratories that new industries are founded. Experimental research is a costly affair. Many failures have to be encountered before success is achieved. Failure frequently necessitates the scrapping of costly plant which has had to be installed. Obsolescence of research plant arising from these causes is at present without any recognition either by the State or by local authorities in levying taxes and rates, although there is a strong case for such allowance.

Publicity for Research

THE director of a large industrial research association remarked recently that adequate publicity is one of the weak spots of research work, and that research is the Cinderella of the scientific world in this respect. The reason for this state of affairs is probably that a large proportion of research directors lack the 'publicity complex'. As the journalist would say, "they bulge with news, but are sublimely oblivious that it is news". If the public, that is, the tax-payers, are to be interested in, and educated about, research work and its value to them, it is necessary that they should be provided with a constant stream of facts to stimulate that interest.

The Department of Scientific and Industrial Research and most individual research associations issue annual reports packed with matter of interest. These reports, in a condensed form, receive a modified measure of publicity through the Press, which is all to the good. But an *annual* stimulus, however good, is totally inadequate to keep alive that interest in research work which is so desirable and necessary. In between the issue of these annual reports, much must occur which is of interest to the public. In the spring of this year, the Association of Scientific Workers came to the conclusion that the time is ripe for establishing a Publicity Bureau for the research associations in Great Britain, and circularised the directors of research associations that it was prepared to arrange for free publicity in the Press on all matters referring to research work which were ripe for release. On the whole, the idea was favourably received; and the Bureau has secured a certain amount of publicity for research work. Much more might be accomplished if those in charge of research would bear in mind the desirability of stimulating public interest in their work if public money is to continue to be granted for its maintenance.

Television at the British Association

DURING the meeting of the British Association at Leicester, demonstrations of television were given by Baird Television Ltd. and by Marconi's Wireless Telegraph Co. Ltd. to illustrate the principles employed in television transmission and reception. The latter also showed the use of a light beam system suitable for the transmission of intelligence over short distances. The television transmitter utilised the principle of indirect scanning by means of a beam of light directed on to the subject through a rotating aperture disc. Fifty horizontal scan lines were employed for each picture and the picture repetition frequency was approximately fifteen per second, the whole equipment being designed to enable pictures of moderately good definition to be sent from any high-class broadcasting station. The amplified electric impulses corresponding to the picture signals were made to modulate the light from a special glow discharge tube, containing sodium and a gas filling of neon. This tube was placed at the focus of a mirror fitted in a searchlight mounting, and a concentrated beam of light, carrying the signals as a modulation, was thereby directed towards the receiver.

THE apparatus at the receiving end comprised the necessary optical system for receiving the light beam and extracting from it the modulation signals through the agency of a photoelectric cell. The picture signals received were then amplified and by means of a Kerr cell they were caused to modulate a high intensity arc used as the light source for the projection of the final image. A mirror drum, rotated in synchronism with the scanning disc at the transmitter, was used to project the picture on a white screen, five feet square. The image thus formed can either be reflected from the screen to the audience or it may be viewed by transmitted light through the screen. The latter method was employed in the demonstrations as it was found that increased illumination was obtained in this way. On the last day of the Association's meeting, Major A. G. Church presented an outline of recent developments in television at a special session of Section A (Mathematical and Physical Sciences). On this occasion also the B.B.C. gave a special dual transmission of both television and sound for the benefit of those attending the meeting.

The John Murray Expedition

THE John Murray Expedition under Col. R. B. Seymour Sewell (see NATURE, May 6, 1933, p. 640) left Alexandria on September 4 in H.E.M.S. *Mabahiss* for the passage down the Red Sea, during which all apparatus is to be thoroughly tested before arrival at Aden. H.M. King Fuad received Col. Sewell and his chief officers and expressed his pleasure in having been able to lend the *Mabahiss* for the Expedition. He showed himself keenly interested in and well acquainted with the scientific problems under investigation. A farewell reception at which the Prime Minister and many high Government officials were present was also given by the Director General of the Indian Marine, El Miralai Ahmed Fuad Bey, on board H.E.M.S. *El Almira Fauzia*. In his eloquent speech he referred to the veneration which is felt by oceanographers of all countries for the name of Sir John Murray and the satisfaction felt in Egypt that "East and West have met in the pursuit of the unknown". He urged the Egyptian personnel to do their best to bring back practical "experience and wide knowledge" for the service of their country, adding "honour to Egypt" and reminding them that "countries are known by their countrymen". Afterwards an inspection was made of the *Mabahiss* which has been fitted with the Hughes Admiralty sounding gear and refrigeration in the Naval Dockyard. The fish hold and scientific quarters have also been largely remodelled so as to give a good chemical laboratory, more cabins and special storage space, while the sides of the deck were picturesque with the trawls, dredges, etc. lashed thereto.

Antiquity of Man in America

RECENT excavations by an expedition of the University of Pennsylvania Museum and the Philadelphia Academy of Natural Sciences at Clovis, New Mexico, under the field direction of Mr. Edgar B. Howard, have brought to light masses of bones of mammoth and of extinct species of horse and bison, together with what are thought to be camel bones, in old lake beds. Although no human bones have been found, numbers of stone spear-points, knives and scrapers have been found in the same beds, not far from the animal remains. Earlier excavations by Mr. Howard in a cave near Carlsbad, New Mexico, revealed hearths at varying depths down to eight feet, with the bones of musk-ox and bison, which had been used for food. Stone spear-points were also found among the debris of the hearths. The evidence from the two sites is taken as lending further support to the view, which is gaining ground among

anthropologists in the United States, that the arrival of man on the American continent must be placed at a much earlier date than that hitherto generally accepted.

A COMMUNICATION dealing with the finds, which has been issued by the Academy of Natural Sciences, quotes certain arguments put forward by Mr. Howard, for the view that man may well have lived in America 10,000 years earlier than the early Basket Makers of the south-west, who are usually dated at about 1500 B.C. He bases this view on the fact that the musk-ox, which was among the animals hunted by the population who used the early type of stone implement known as the Folsom point, is a cold weather animal which must have died out in New Mexico with the retreat of the last glacial sheet. The evidence which has been gathered recently of the early character of these stone implements is impressive, even though no absolutely conclusive evidence for the earliest dating claimed has yet been adduced. Mr. Howard supports his views by reference to the human remains of supposedly early date which have been found in America. No one, however, has as yet successfully traversed Dr. Hrdlička's destructive criticism of their claims to high antiquity.

Shetland in the Bronze Age

MR. A. O. CURLE'S excavations on a prehistoric township at Sumburgh Ness, Shetland, on behalf of the Office of Works, an account of which appeared in the *Times* of September 16, convey a remarkable impression of a community which endured for a considerable period of time, remote and self-contained, but busily engaged in pastoral and industrial pursuits, and living a life, for the times, by no means squalid in its surroundings. One of the most interesting features revealed in the excavations of the season which has closed recently was the series of five elliptical chambers in the earliest of the three periods of occupation of the circular construction adjacent to the dwelling examined in a previous season. These chambers were constructed against the interior wall and opened on to a central area in which was a hearth. Some at least of these chambers had been used as workshops or storehouses. From one were taken more than forty rude stone tools of the type peculiar to Shetland, while around the hearth lay various fragments of clay moulds for making swords. As these were unused, this was evidently a place of manufacture. In the following layer of occupation, moulds for both swords and axes were found, one being a section 10 in. long, of a complete mould, still unused. The neatly paved stone or clay floors in the earlier phase of occupation, and the two boxes of slate slab in one of the chambers, nearly filled with broken bones, suggest an instinct for tidiness which is as pleasing as it is unexpected. The earliest occupation is bronze age; evidence of Hallstadt influence appears in the pottery of the second phase of occupation; and a small piece of iron slag in the third level indicates the entry of the settlement into the iron age.

Racial Types in Bronze

MUSEUMS in the United States, in order to strengthen the appeal of their anthropological collections to the public, rely to a considerable degree upon the aid of sculpture and models. The latest addition to the Field Museum, Chicago, is a hall which is devoted to the races of mankind. Here the ethnological problem is presented through the medium of a series of bronzes. The hall is named the Chauncey Keep Memorial Hall, in memory of a former trustee, the late Chauncey Keep, who died in 1929, leaving to the Museum a legacy of 50,000 dollars, which has been devoted to this purpose. Contributions towards the cost of the bronzes were made by Mr. Marshall Field, Mrs. Stanley Field, and Mrs. Charles H. Schweppe. The bronzes were executed by Malvina Hoffman, who studied her models in Africa and the Far East. There are, in all, seventy-four figures representing the principal or most characteristic types in all the continents. A considerable proportion are life-size full-length figures, the remainder heads or busts. A description of the hall and exhibits illustrated by photographs has been written by Mr. Henry Field under the title "The Races of Mankind" (Field Museum of Natural History, Anthropology, Leaflet 30) with an introduction by Sir Arthur Keith and a preface by Dr. Berthold Laufer.

Metallurgical Research and Education

DURING the recent meeting of the Iron and Steel Institute in Sheffield a large party of members visited the East Hecla Works of Messrs. Hadfields, Ltd., on September 14. Sir Robert Hadfield, chairman of the company, delivered an address which he has printed in an amplified form and abundantly illustrated. As on similar occasions, Sir Robert has taken the opportunity of surveying a wide field of metallurgy, and in this instance he has covered the ground of metallurgical research and education, with special reference to Sheffield, in a very thorough manner. The booklet, of 106 well-printed pages, will be found valuable for reference, and many readers will be glad to see the large number of portraits, some of which are not readily accessible and must have called for much diligent search. Much of the material has appeared in the author's larger books, but is here presented in a convenient form, based on an intimate knowledge of the history of the steel industry of the district, from the primitive forge to the modern high-frequency furnace.

A Famous American Engineer

IN the July number of *Mechanical Engineering*, the journal of the American Society of Mechanical Engineers, Prof. J. A. Hall and Mr. G. W. Richardson give an interesting account of the life and work of George Henry Corliss (1817–1888), "one of the leading pioneers in the development of power generation from Watt to the present day". Though Corliss received no mechanical training and started life as a storekeeper, his invention, at the age of

twenty-six years, of a machine for stitching leather harness brought him the offer of a post as a draughtsman in the firm of Fairbanks, Bancroft and Co., of Providence, R.I., and in 1847 the name of this concern was altered to Corliss, Nightingale and Co., with Corliss at its head. Corliss will always be remembered for his invention of the 'Corliss' valve gear for steam-engines, in connexion with which he took out many patents, the first being secured in 1849. His engines gradually became known for their economy in steam consumption and their regular turning movement. A Corliss engine exhibited at the Paris Exhibition of 1867 took the highest prize, and out of 400 engines exhibited at Vienna in 1873 the majority were of the Corliss type. His most famous engine was that constructed for the Machinery Hall of the Centennial Exhibition at Philadelphia of 1876 which was set in motion at the opening by Emperor Dom Pedro II of Brazil. This engine had two cylinders 40 in. diam. by 10 ft. stroke driving a 30-ft. flywheel through overhead beams. At 34 r.p.m. it developed 1,400 h.p. The machinery in the Hall was coupled to the engine by means of shafting and gearing beneath the floor. Original and independent in all his views, Corliss was generous as an employer and upright and outspoken as a public man. The sketch of his life in *Mechanical Engineering* is accompanied by a good photograph of him.

Seeing Sound at the Chicago Exhibition

THE exhibits of the Bell Telephone Co. at the Chicago Exhibition are of considerable interest. By means of a rotating mirror, beams of light are successively picked up from a small mirror on the receiver and flashed on a screen where they can be seen by a large audience. The speed of the mirror is regulated so as to give the best effect for sound and music. Typical speech sounds are listened to and at the same time their wave form is shown on the screen. High-pitched sounds show waves close together, and loud sounds result in waves of great height. Filters of various types are inserted and their effect in cutting out certain frequencies are both seen and heard. In the *Bell Laboratories Record* for August a full account is given by Mr. R. F. Mallina of these exhibits. A photograph is shown of the combined signal produced when twelve telegraph messages are transmitted simultaneously along a wire. Visitors to the exhibit can listen to the curious medley of musical sounds produced in the loud speaker. The combined sound gives no hint of what the messages are. When the complex current goes into the terminal apparatus the twelve different messages are all duly sorted out. Of particular interest was the separation of the rectangular pulses of direct current which operate teletype instruments from the corresponding high-frequency impulses caused by the combination of the carrier wave with the signal wave. The apparatus should prove useful in lecture rooms when it is necessary to explain the characteristics of various vibratory phenomena.

Roofs made of Sheet Steel

A NOVEL application of electric arc welding has recently been begun in the United States. Roofs are made of long strips of sheet steel which are assembled and welded on the ground and then hung up between the top and bottom of the roof. The shape in which they hang is approximately that of a catenary and they are welded together. In the *Electrical Review* of August 25 a description is given of the 'self-supporting' roofs erected on four huge grain elevators at Albany, New York. These roofs are watertight and have no columns or stanchions to support them. Maximum storage capacity is thus obtained. Each roof measures 288 ft. wide with a total span of 140 ft. and is composed of 76 steel sheets 140 ft. in length and 50 in. wide. The lower support of the roof starts approximately 22 ft. above ground level and extends upward at an angle of 30°–40°. Both the top and bottom supports were constructed at an angle to conform with the slope of the roof. By welding in various ways, expansion and contraction troubles are avoided. Small expansion joints were welded at suitable places over the longitudinal spans so as to allow free expansion for the roof. On completion, the roofs were given two coats of red lead and one of aluminium paint. With eight operators the speed of welding averaged 50 ft. per hour. More than 400 tons of sheet steel of No. 12 gauge were used.

Increased Safety for Lift Passengers

LIFTS for passenger service are being increasingly adopted in our larger cities. This is partly due to the erection of buildings of greater height in centralised positions. Anything therefore which adds to the safety and convenience of these devices is of importance. In the Osram General Electric Company's *Bulletin* for June, a description is given of a new device which ensures the safety of passengers from being struck by sliding doors whether they are operated by electric or pneumatic means. A beam of light is focused across the lift car entrance on to a photo-cell. Passengers entering or leaving the lift must of necessity interrupt this light beam. The effect of breaking the beam ensures either that the doors remain in the open position or, if they have started to close, that they will open again. All the time the beam of light is broken it is impossible to close the doors to the lift. The whole of the necessary apparatus can be fitted on the lift car and thus only one unit per lift is necessary. A unit comprises an adjustable projector arranged to focus light on a self-contained photo-cell set which operates relays in the motor room connected with the power doors. Structural alteration to standard types of lifts is not involved.

Pulverised Fuel for Marine Boilers

ALTHOUGH use of pulverised fuel has made great progress in steam boilers on land, similar results have not been achieved in marine boilers for various reasons. One of these is the great size of the combustion chamber hitherto found necessary. The rate of

combustion is determined by the rate at which air and fuel come into contact. With lump fuel this can be accelerated mechanically, but with powdered fuel actually moving with the air stream, it is difficult to secure relative motion between the two and probably diffusion is the limiting factor. Turbulence may promote mixing, but not necessarily accelerate diffusion. At the Fuel Research Station an attempt has been made to secure rapidity of combustion by the design of a 'grid' burner so constructed that the primary air and the fuel are fed in a number of thin layers with secondary air sandwiched in between them. The burner air is cooled by tertiary air introduced at the periphery. With this burner and the coal of volatile matter content down to 21 per cent, satisfactory and flexible combustion was attained with a compact flame. The satisfactory nature of the combustion is indicated by the low proportion of carbon—7 per cent—found in the ash leaving the furnace. The results of tests of this burner form the subject of Fuel Research Technical Paper No. 36, "Pulverised Fuel—the 'Grid' Burner" (H.M.S.O. 6*d*. net).

Tabular Data on Photographic Films

THE *Jahrbuch des Meteorologischen Observatoriums auf dem Donnersberge* (*Böhmen*) for 1929, edited by Dr. Pollak, is a very slender volume compared with its predecessors. The explanation is that, partly from motives of economy, the usual tables which make up most of the volume have not been printed. Instead they have been typed, and the typescript has been 'filmed' on Agfa non-inflammable films, the whole of the tabular matter being set out in a continuous ribbon made up of individual pictures 18 mm. wide and 24 mm. in height which accompanies the printed portion in a small tin box. This ribbon, which measures considerably less than 2 metres in length, can be rolled into a compact cylinder of cross section less than 2 cm. in diameter and in that form occupies less space than a small box of matches, the weight being extremely small. It is evident that had the whole year-book been treated in the same way the above rough description of its size and weight would still have applied to it, whereas the corresponding volumes for previous years are nearly 1 centimetre thick, and have pages measuring 31 cm. × 23 cm. In the 1928 volume Dr. Pollak discussed the method of reproduction of his year-books by filming. He illustrates and describes there an apparatus manufactured by Askania-Werke A.G., Berlin-Friedenau, with the aid of which successive portions of the reel are strongly illuminated and can be brought under a powerful magnifier, but this arrangement appears very awkward for anyone using a table at one end of the film and requiring to make frequent reference to tables at the other end. It is not easy to see how this difficulty can be surmounted—the provision of fast and slow movements corresponding with the coarse and fine adjustments of a microscope would not be a complete solution.

THE need for rapid cross-reference in certain types of work appears to us to be so great that, until it can be met, it is superfluous to enlarge on the many virtues possessed by this photographic system (for example the ease with which books made in this way can be used with the aid of a lantern in teaching or public lecturing, the saving in postage when sending 'books' by post, and the saving in costs of publication). Moreover, another important drawback is that in a library composed of such books, there would have to be enough magnifiers and illuminators to supply the needs of all persons who might wish to use the library at the same time. It is an interesting venture, and one is left to wonder whether the growing difficulty of so many libraries—that of finding accommodation for such an increasingly massive accumulation of written knowledge—may not focus attention more and more on to revolutionary lines of development such as the one indicated by Dr. Pollak. Improvements in the quality of cinematograph films may make possible a much greater reduction of size, and the use of some system of magnification yielding a large field of view might lead to the abandonment of the reel form of film and conceivably open up ways of making cross reference easier in the new than in the old system.

Importation of Plants into Great Britain

THE Ministry of Agriculture has recently strengthened the regulations governing the importation of plants into England and Wales by a new order, entitled "The Importation of Plants Order of 1933" (London: H.M. Stationery Office. 2*d*. net). This came into operation on July 15, and requires all imported consignments of living plants and parts thereof (except seeds) for planting, and all potatoes, to have been officially examined by the authorities of the country in which they were grown and certified as having been found to be healthy and free from any evidence of the presence of any insect or fungus pest destructive to agricultural or horticultural crops. This requirement is not limited as in the previous regulations to plants "with a persistent woody stem above ground", but applies to all classes of living plants. An additional certificate is required, as hitherto, in respect of plants grown in France, to the effect that the Colorado beetle has not been known to exist within 200 kilometres of the place where the plants, etc., were grown. The order provides for the treatment of consignments which arrive without the necessary certificates of health. Additional regulations are enforced to safeguard potatoes from wart disease and also in regard to cider apples imported between March 15 and October 14, while restrictions are continued on the importation of raw apples grown in the United States.

Increase of Canadian Plains Bison

IN 1907 the Pablo herd of 716 American bison, the remnant of the innumerable multitudes of a century before, was purchased by the Canadian Government. Of these, 631 were established in Buffalo National Park and the remainder formed the basis of a herd, now more than a thousand strong, in Elk Island National Park. Since the

establishment of the Buffalo Park herd the numbers have increased rapidly: in all, 6,673 have been shipped alive to be established in the northern Wood Buffalo Park in the North West Territories; including those of 1932, a total of 8,680 have been slain, and the meat, hides and heads disposed of; and there remain in Buffalo Park 6,300 individuals. So that the minimum total of individuals bred there from the original 631 is 21,653; but many must have died a natural death (and there are persistent rumours of tuberculosis in the herd) and there may have been an increase also in Wood Buffalo Park. The experiment of transferring one race of bison, the plains variety, to the sole territory of another and dwindling race, the wood bison, was viewed with much concern by naturalists when it began in 1925, and it would be reassuring if the Department of the Interior of Canada would issue some information, not only about the welfare of the transferred animals (which they have done), but about the welfare of the wood bison the territory of which was invaded, and about the chances or reality of cross-breeding between the two forms.

Men of the Trees

WHILST a forest officer in East Africa, Mr. St. Barbe Baker formed a small society, which he named the 'Men of the Trees', to encourage the tribesmen to curtail the thoughtless, wasteful destruction of the forests which is still so common a feature in many parts of the world. On his return home, Mr. Baker started the Association bearing this name (The Men of the Trees) in Great Britain, the Association now being in its ninth year. The broad aim of the Men of the Trees, as exemplified by the motto, is "To develop a tree sense in every citizen and to encourage all to plant, protect and love trees everywhere", is applicable to many parts of the British Empire. The Society's object is even wider for it "not only encourages the protection, preservation and beautifying of the countryside, since no village or landscape can be complete without its trees—but its range is both national, imperial and international. It appeals equally to all creeds and to all classes". Enthusiasm for the tree in its many varying degrees of importance is the main note and its claims to form a point of union for all those to whom trees and the life of trees have an instinctive appeal. Probably, one of its most valuable activities, so far as the future is concerned, is the endeavour to interest the young people, guides, scouts and school children generally, in tree-planting and the protection of planted trees. The address of the Secretary of the Association is 32 Warwick Road, London, S.W.1.

Lost Birds of Madagascar

IN addition to two short articles dealing with the preservation of wild life in Sierra Leone and Gambia, and a summary of the very important report of the Malaya Commission, the current number of the *Journal of the Society for the Preservation of the Fauna of the Empire* contains a discussion concerning two little-known extinct birds of Madagascar. The 'poulet rouge', a flightless bird with a kiwi-like appearance, and the 'corbeau indien', a stout-bodied, parrot-like bird with a crest upon its forehead, are unknown except for some odd bones and a few contemporary drawings. Dr. Graham Renshaw has collected the meagre information which exists about these curious birds, one apparently a ground bird, the other arboreal, and has illustrated his description by representations of the birds as they appear to have existed.

Development of the Lightning Discharge

REFERRING to the letter in NATURE of September 9, p. 407, by Schonland and Collens on the development of the lightning discharge, Mr. S. E. Ashmore, 22, Soho Road, Birmingham, 21, writes to suggest that the noise heard in a wireless receiver during a storm affords confirmatory evidence. The first 'click', heard a fraction of a second before the actual flash is seen (*Meteorol Mag.*, 68, 114, 139; 1933), may be due to the preliminary downward avalanche of electrons. The lightning flash 'heard' afterwards is that which Schonland and Collens describe as progressing by thermal ionisation.

Announcements

DR. HERBERT E. IVES, of the Bell Telephone Laboratories, New York, will deliver the Thomas Young oration before the Physical Society at the Royal Institution, 21, Albemarle Street, London, W.1, on October 6. Dr. Ives's subject will be "Thomas Young and the Simplification of the Artist's Palette".

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, New Bond Street, W.1, have issued a new catalogue (No. 475) containing a selection of books on zoology and geology. The catalogue contains 1,966 items, the largest section being that of entomology, which contains some important works from the libraries of Ernest and Léon Candèze.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant lecturer in mathematics at the University of Leeds—The Registrar (Sept. 27). A horticultural adviser in Jersey—The Greffier of the States, States' Greffe Office, Royal Square, St. Helier, Jersey (Sept. 30). A librarian for the Pharmaceutical Society of Great Britain, 17, Bloomsbury Square, London, W.C.1—The Secretary (Oct. 3). A technical assistant for the Southend Education Committee—The Director of Education, Education Office, 20, Warrior Square, Southend-on-Sea (Oct. 4). An advisory officer on farm economics for the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, York Buildings, Edinburgh, 2 (Oct. 12). A professor of anthropology at the University of Sydney—The Registrar (Dec. 2.—Further particulars from the Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1).

ERRATUM.—Prof. Hans Schinz, of Zurich, informs us that Dr. Otto Stapf died at 6.30 a.m. on August 4 and not on August 3, as stated in NATURE of August 26.

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.*]

Theoretical Basis of the Human Chromosome Map

Two years ago, Bernstein[1] published an account of a statistical method for determining linkage between two genes located on the same autosome, when only two generations, including parents of unknown ancestry, are available for the assay. This contribution was a signal event for human genetics. It disclosed the possibility of constructing a map of the human chromosomes. With a suitable theoretical technique the practical difficulties seem to be less than they once appeared to be, chiefly on account of a growing body of information concerning gene substitutions with allelomorphic frequencies of the same order of magnitude. Such, for example, are illustrated by the isoagglutinin types, the new hetero-agglutinin groups of Landsteiner and Levine, and taste blindness for phenylthiourea compounds. An investigation of linkage in connexion with clinical data undertaken by this Department assisted by the Medical Research Council prompted the writer to examine Bernstein's treatment more closely than he had previously done. It would seem that Bernstein's basis formula is only valid under restricted conditions for one class of mating to which it is applied, and is not at all valid for the other. Consequently certain of his tables need to be recalculated before they can be used for the analysis of clinical data.

Bernstein deals with two classes of matings: $AaBb \times aabb$ and $AaBb \times Aabb$. Two theoretical difficulties arise (i) because, when we know that an individual has the constitution $AaBb$ we cannot tell whether a and b are on the same chromosome or alternative members of a pair, (ii) because we cannot recognise a parent as belonging to the genotype $AaBb$, unless its progeny include, either some offspring ab, or offspring belonging both to Ab and aB. To overcome the first difficulty, Bernstein makes use of the following consideration. For the two classes of mating specified above, the theoretical frequencies of offspring belonging to AB and Ab and to ab and aB are interchangeable according as a and b are or are not on the same chromosome in the parent $AaBb$. If, taking one alternative, we denote the probability that an offspring will belong to AB, ab, Ab and aB by d, e, f, g, the mean value of the product formed by multiplying the number of offspring (μ) belonging to AB or ab and the number of offspring (ν) belonging to Ab or aB in an s-membered fraternity is

$$ {}^{s}_{c}(\mu\nu) = s(s-1)(d+e)(f+g) \qquad (1) $$

In this expression, d, e, f, g, are known functions of c the crossing-over value, and can be tabulated for different values thereof. They are different functions of c according to whether we are considering matings $AaBb \times aabb$ or $AaBb \times Aabb$, and since in either case the values of d and f and of e and g are interchangeable according as a and b are on the same chromosome or on different chromosomes, the value of (1) is the same whatever the relative frequency of the two types of parents belonging to the genotype $AaBb$ happens to be.

In general, the first formula is not suitable for human data, because we can only recognise matings of the two classes specified when the offspring are not exclusively of the phenotypes AB and Ab or of AB and aB. Since the size of the human family is small, the exclusion of these families lowers the expected mean value of the product appreciably. For this expected value ${}^{s}_{c}(\mu\nu)'$ Bernstein gives the formula

$$ {}^{s}_{c}(\mu\nu)' = K \,.\, {}^{s}_{c}(\mu\nu) \qquad (2) $$

The correction factor K is assigned the value

$$ K = \frac{1-\frac{1}{2}\{\,2(d+f)^s+(d+g)^s+(e+f)^s\,\}}{1+\frac{1}{2}(d^s+f^s)-\frac{1}{2}\{\,2(d+\quad)^s+(d+g)^s+(e+f)^s\,\}} \qquad (3) $$

In deriving the numerator of (3), Bernstein assumes the identity (p. 130) of certain terms which appear to have merely formal similarity. This only involves identity, when $d=e$ and $f=g$, a condition which is fulfilled for matings of the class $AaBb \times aabb$. It is not fulfilled for matings of the class $AaBb \times Aabb$. Bernstein's proof assumes that among parents $AaBb$, a and b occur with equal frequency on the same chromosome or on alternative members of a pair, as is true after many generations of random matings (Haldane). With this restriction the correct formula would appear to be

$$ {}^{s}_{c}(\mu\nu)' = \frac{\frac{1}{2}s(s-1)\{\,2(d+e)(f+g)-2df(d+f)^{s-2}-dg(d+g)^{s-2}-ef(e+f)^{s-2}\}}{1+\frac{1}{2}(d^s+f^s)-\frac{1}{2}\{2(d+f)^s+(d+g)^s+(e+f)^s\}} \qquad (4) $$

For matings of the class $AaBb \times aabb$ we use the relations $d=e=\frac{1}{2}(1-c)$ and $f=g=\frac{1}{2}c$. For matings of the class $AaBb \times Aabb$ we use the relations $d=\frac{1}{4}(2-c)$, $e=\frac{1}{4}(1-c)$, $f=\frac{1}{4}(1+c)$ and $g=\frac{1}{4}c$. The two formulæ (2) and (4) give the same values for matings $AaBb \times aabb$ and different results for $AaBb \times Aabb$. Thus if (4) is right, Tables 2a and 4a in Bernstein's memoir need recalculation.

It is to be noted that the computation of such tables is only of value upon the assumption that the system of observed matings approximates to one in which random mating has continued for many generations. The value of the mean product (and of its variance) is only independent of this assumption when $c=\frac{1}{2}$. Side by side with this limitation may be placed a consideration which Bernstein overlooks. This is that when $c=\frac{1}{2}$, the value of the mean product and its variance is independent of the assumption that continued random mating has occurred for matings $AaBb \times AaBb$ so long as c has the same value in both sexes. When dealing with rare recessive genes, the exclusion of this third class of matings would be a serious disability of the product method. In practice, the extent to which we are entitled to rely on the product method to assign a value for c might be gauged by comparing results for different classes of matings. The fact that the above assumption is irrelevant when $c=\frac{1}{2}$ makes the method adequate as a test for distinguishing between linkage and independent assortment.

There is a simple way of testing whether formula (2) or (4) is correct. For a family of s members the frequencies of each type classified with respect to the number of members belonging to the several phenotypes are represented by successive terms in the expansion of the multinomial $(d+e+f+g)^s$. For each frequency class the number of individuals in each phenotypic class is given by the exponents of the symbols representing the probability that an individual will belong to one of the four classes in particular. The values of μ and ν are thus respectively

the sums of the exponents of d and e and of f and g. Assuming that a and b occur with equal frequency on the same chromosome or on alternative members of a pair, it is necessary to construct two parallel series representing the two possibilities by interchanging the numerical values of d and f and of e and g, giving both series equal weight. Rejecting families which are indeterminate because only AB and Ab or only AB and aB are represented, we thus obtain a mean value of 2·225 for $\mu\nu$ when $s=4$ and $c=\frac{1}{4}$ for matings $AaBb \times aabb$. This agrees with both (2) and (4), and with Table 1*a* based on (2) in Bernstein's memoir. For matings $AaBb \times Aabb$, we obtain 2·733 in agreement with (4) but not with (2) or Table 2*a* which gives 2·686.

The writer hopes later to publish tables of the mean product and its variance suitable for all three classes of matings.

LANCELOT HOGBEN.

Department of Social Biology,
University of London.
July 29.

[1] *Z. Indukt. Abst. Vererbungslehre*, **57**; 1931.

Removal of Metallic Deposits by High-Frequency Currents

IN examining the spectra of high-frequency discharges in metallic vapours, it was noticed that the wall deposits which had developed under certain conditions disappeared under the electrodes when the field was applied externally. For example, a quartz tube which some years ago had been used to carry an electrodeless discharge, in hydrogen plus iodine, was lying about the laboratory. Its internal wall was covered with a tolerably dense brown coating which moderate heating failed to remove. On applying a high-frequency field by means of external wire electrodes so that a luminous discharge was obtained (in air at a pressure of a few millimetres), in a few minutes the deposit was removed in the neighbourhood of the electrodes. By shifting the position of the electrodes, the whole tube was cleaned in a short time.

During the past two or three months this effect has been examined somewhat carefully, although the following results need to be amplified and extended. The work to date has been restricted to the use of a wave-length of 145 m., with electrode distances for the most part either 4 or 5 cm. Almost all observations have been made with tubes lightly silvered (by the Rochelle salt process), as these proved extremely suitable and could be quickly prepared. As the phenomenon is obviously intimately connected with the ring deposits of mercury in similar tubes, to which Banerji and Ganguli[1] have recently directed attention, the deposit effect was also examined for mercury and for iodine. Attention is directed to the following results.

(1) The removal (and deposit) shows a definite pattern, not always simple, the structure of which is definitely related to the nature of the discharge. This is clearly shown in Figs. 1 and 2 in each of which *b* is an actual photograph taken by placing sensitised paper inside the tube. Black regions, therefore, correspond to clear portions of the tube. The diagrams marked *a* indicate the general appearance of the discharge, the shaded part being luminous. *E* and *E* give the positions of the electrodes, while *c* is a curve giving a visual estimate of the intensity of the deposit. The dotted line represents the original intensity of the coating on the tube.

(2) A high-frequency potential applied to the electrodes caused no removal unless a gas or vapour was present to carry an actual discharge. Most of the work was done with air as the ionised gas but a few observations with hydrogen, nitrogen and oxygen showed that with hydrogen and oxygen the action was extremely rapid, with nitrogen very much less so.

(3) Although Pyrex glass was used for the most part, the effect is obtained with soda glass and with quartz.

(4) That the inner surface of the tube undergoes a marked and at least a semi-permanent change was shown by running the discharge in an unsilvered tube

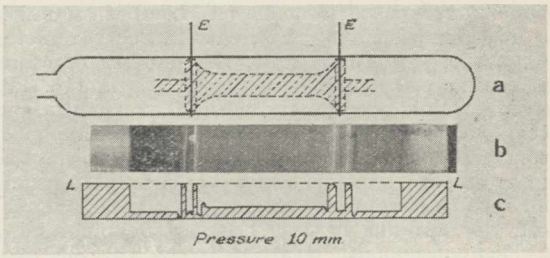

FIG. 1.

and silvering afterwards. A well-defined structure was obtained in this way. Neither strong heating nor a delay of one week, before the silvering was done, destroyed the pattern thus obtained.

(5) The complexity of the pattern depends on the length of time the discharge is allowed to run. To eliminate temperature effects, the discharge was run intermittently and a cooling blast of air played continuously on the tube. With such an arrangement, sometimes a removal occurred under the electrodes in a single flash the duration of which was less than one-fifth of a second. With successive flashes the appearance gradually altered, the complexity increasing,

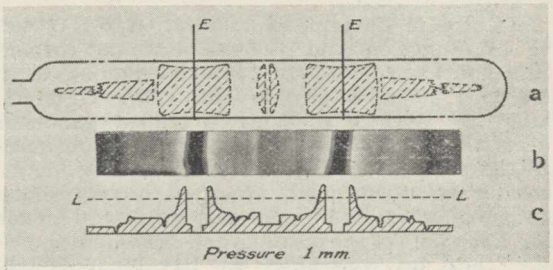

FIG. 2.

until a run of perhaps half an hour or an hour had been made. Removal regions a couple of centimetres beyond the electrodes were always very much slower in appearing than those near the electrodes.

(6) Similar well-defined deposits were observed in tubes carrying discharges in air plus mercury or iodine vapour. Banerji and Ganguli report only uniform deposits with iodine, but in our experiments no difficulty was experienced in obtaining well-defined ring patterns. Before the temperature control device was used, it was observed that deposit rings might be formed temporarily, afterwards to disappear, probably due to the rising temperature of the tube.

It is hoped that a further study of this phenomenon

may provide information regarding the nature of the mechanism of high-frequency discharges, as well as their action on the walls of containing tubes.

J. K. ROBERTSON.
C. W. CLAPP.

Queen's University,
Kingston, Canada.
Aug. 3.

[1] Banerji and Ganguli, *Phil. Mag.*, **15**, 676; 1933.

Complex Chromium and Iron Carbides

THE carbide phase of a stainless steel containing about 13 per cent chromium and 0·3 per cent carbon has the same crystal structure as the lowest of the chromium carbides[1]. The latter, which contains about 20 atomic per cent carbon, has been found to be face-centred cubic. From its lattice parameter, 10·64 A., and density, 6·97, the number of atoms in its unit cell may be calculated; it is 116. Its formula should accordingly be $Cr_{23}C_6$. As this, however, is contrary to the rule of simple stoichiometric proportions, it was considered more probable that in the unit cell were present not 116 but 120 atoms, and that the true composition of the carbide[2] agreed with the formula Cr_4C. The carbide of stainless steel has consequently been denoted by $(Cr,Fe)_4C$ (iron content up to about 25 atomic per cent).

A determination of the atomic grouping of the cubic chromium carbide has now proved that its formula is in fact $Cr_{23}C_6$. Its space group is O_h^5, and using Wyckoff's notation the atomic positions are:

4 Cr at 4(*a*), 32 Cr at 32(*f*), ($u = 0{\cdot}385$),
8 Cr at 8(*c*), 48 Cr at 48(*h*), ($v = 0{\cdot}165$),
24 C at 24(*d*), ($w = 0{\cdot}275$).

The intensities of the reflections calculated on the assumption of this structure agree perfectly with those observed.

In a chromium-tungsten carbide of this type, containing about 7 atomic per cent tungsten, the tungsten atoms occupy mainly the points of 8(*c*). The formula of this substituted carbide may thus be written $Cr_{21}W_2C_6$.

As stated in a recent communication to NATURE[3], the iron-tungsten and iron-molybdenum carbides present in low tungsten and molybdenum steels are analogous in structure to the cubic chromium carbide. With but slightly modified parameter values, the positions of the atoms in these substances are the same as in $Cr_{23}C_6$. Also in these double carbides the heavier metal atoms are not distributed at random among the iron atoms, but occupy preferably the points of the position 8(*c*). These substances may thus be considered to be $Fe_{21}W_2C_6$ and $Fe_{21}Mo_2C_6$, in which tungsten and molybdenum to some extent are substituted by iron.

A. WESTGREN.

Institute of General and Inorganic Chemistry,
University,
Stockholm. Aug. 25.

[1] *J. Iron and Steel Inst.*, 117, 383; 1928.
[2] *K. Vetenskapsakademiens Handl.*, III: 2, No. 5; 1926.
[3] NATURE, 132, 61, July 8, 1933.

Constitution of Water in Different States

IN a former publication[1], the changes in the distribution of intensity of the Raman band of water with temperature have been explained on the hypothesis that water consists of three types of molecules, single (H_2O), double ($H_2O)_2$ and triple ($H_2O)_3$, as revealed by the presence of three components in the band. Since these components were mixed up, it was not then possible to analyse the band to estimate quantitatively their relative intensities, for the determination of the proportions of these three types of molecules. Further work with ice and water at 0°, 4°, 38°, and 98° C. has now made such an analysis possible.

Ice is found to give a band consisting of two components only with Raman frequencies 3196 cm.$^{-1}$ and 3321 cm.$^{-1}$. Daure[2] obtained, with water vapour, a sharp line with the above frequency equal to 3655 cm.$^{-1}$. In water at different temperatures, all the above three components are found with varying relative intensities. On the assumption that ice consists of only the double and triple molecules, its Raman band is analysed, from which the positions of the components corresponding to the double and triple molecules are known. Knowing also the position of the component attributed to the single molecules from the Raman spectrum of water vapour, the intensity curves for the band at different temperatures of water are also analysed on the assumption that the positions of the three components are the same in all the states. From the intensities of the components thus analysed are calculated the relative proportions of the single, double and triple molecules, which are assumed to be directly proportional to the above intensities. The values thus obtained are:

	Ice	Water (0°)	Water (4°)	Water (38°)	Water (98°)
H_2O	0	19	20	29	36
$(H_2O)_2$	41	58	59	50	51
$(H_2O)_3$	59	23	21	21	13

The maximum number of double molecules in water at 4° perhaps explains the maximum density of water at this temperature, as the graphic formula for these molecules indicates that it is more compact than the triple molecules. Since these latter type predominate in ice, the packing of molecules is less dense in this state, thus leading to its smaller density.

The only quantitative determination of the proportions of these is that by Sutherland[3] from values of the specific volume of water at different temperatures. This is, of course, an indirect method, whereas that adopted by me is more direct.

I. RAMAKRISHNA RAO.

Andhra University,
Waltair.
Aug. 10.

[1] *Proc. Roy. Soc.*, A, **130**, 495; 1931.
[2] *C.R.*, 192, 1721; 1931.
[3] *Phil. Mag.*, **50**, 460; 1900.

Electrostatic Deflection of Positive Electrons

IT is already known that the so-called 'positive electron' is deflected in a magnetic field. We are able now to deflect it in an electrostatic field.

The experimental arrangement may be shortly described as follows: the source of positive electrons is placed in an evacuated box, between the pole pieces of an electromagnet, but in the marginal region of non-uniform magnetic field. If a film be placed along the same diameter of the pole pieces, opposite to the source, a photographic record may be obtained of the positive electrons.

Thus, the positive particle describes short circles

(a few millimetres in diameter) which suffer a precession so that the final path is a cycloid from the source on to the recording film. A series of experiments may be tried on this positive spot. For example, if we insert a material screen in the path of the positive rays, we observe that the latter easily penetrate a silver sheet, 0·04 mm. thick; but 0·5 mm. of aluminium strongly reduces the beam, and 1 mm. absorbs it almost completely.

On the other hand, when two plane parallel grids are inserted, perpendicularly on the cycloid path, and a potential difference is applied to them, we may

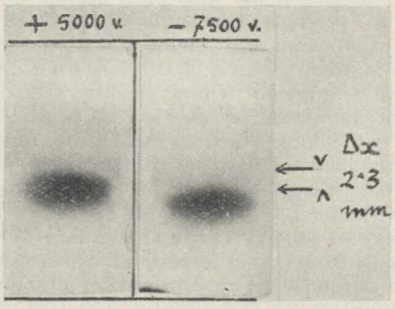

FIG. 1.

expect the path, and consequently the photographic record, to be displaced. In fact, the experiments have shown a radial distance of about 1 mm. between the two positions of the spot, for a potential variation of 5,000 volts. The sense of this displacement is such as to point to an attraction of the particle by the negative grid. Fig. 1 shows the two different positions of the spot, one electrode being earthed, and the other fixed at a potential of +5,000 and −7,500 volts respectively.

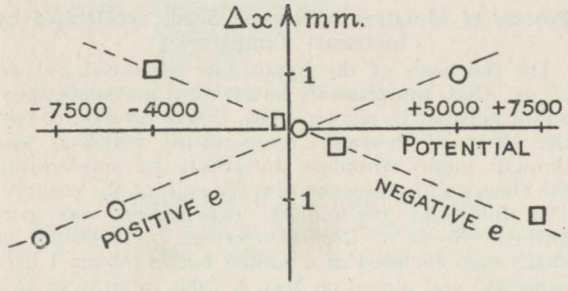

FIG. 2.

When reversing the magnetic field, we record on the film the negative electrons from the same radioactive source, and the negative line may be displaced in the electric field so as to reveal, for the same potential variation, *equal* but inverse deflection of the beam. In Fig. 2 the different positions of the spot are plotted against the grid potentials for positive and negative electrons respectively.

Thus we see that the specific charge of the new positive electron must be of the same order of magnitude as that of the negative electron—quite different, for example, from the specific charge of the proton. A more accurate determination of e/m_0 for the positive electron is now being made.

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New Band Systems in the Gadolinium Oxide Spectrum

WITH the same arrangement of the oxyhydrogen flame used to obtain low excitation spectra of the oxides of lanthanum, praseodymium, neodymium and samarium, I have been able to volatilise completely the oxide of gadolinium and to photograph its spectrum in the visible region.

The spectrum thus obtained shows, in addition to the already known band systems in the red region, two new systems in the blue region. The origin of these systems is at λ4615·6 and λ4892·1. The systems can be represented by the formula:

$$\nu = 21659{\cdot}5 + 350{\cdot}65(n'+\tfrac{1}{2}) - 96{\cdot}32(n'+\tfrac{1}{2})^2 - 387{\cdot}70(n''+\tfrac{1}{2}) + 108{\cdot}58(n''+\tfrac{1}{2})^2.$$

$$\nu = 20435{\cdot}0 + 360{\cdot}83(n'+\tfrac{1}{2}) - 97{\cdot}38(n'+\tfrac{1}{2})^2 - 392{\cdot}89(n''+\tfrac{1}{2}) + 108{\cdot}54(n''+\tfrac{1}{2})^2.$$

These two systems appear very bright at the flame temperature but disappear completely at the arc temperature.

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Co-operation in Science

REALISATION of the essential unity of science leads to the perception of the need for co-operation of workers in all its branches. Various suggestions are put forward, but complete co-operation cannot be secured, except on a bibliographical basis; for information cannot be given until it has been ascertained. The fundamental difficulty is the lack of co-operation in bibliographical services. Three hundred abstracting and indexing journals together produce annually three quarters of a million abstracts or index entries, the same number as that of the important scientific and technical articles published. Yet only one third of these articles is indexed or abstracted. The cause of this failure lies in the fact that it is almost impossible to make a complete index of the literature of a particular subject by present methods. One third or less of that literature is contained in a nucleus of periodicals, which purport to cater for that subject. The remaining two thirds, or three quarters, is scattered among thousands of periodicals, which contain articles at the rate of from one a year to one in ten years or less. To compile a complete index to the information on any subject, a mass of periodicals must be scrutinised, the yield from which individually is not worth the trouble. But in bulk it far exceeds the total of papers contained in the special periodicals.

A complete change in methods of indexing is needed. Periodical literature must be abstracted by source and not by subject. This needs the general adoption of a standard classification so that information on the same subject will be brought together, no matter from what source, or by whom it is indexed. Then the energy available is sufficient to produce the desired index at once.

Such a classification is to hand in the Universal Decimal Classification of the International Institute of Bibliography. Its suitability is proved by the gradual increase in its use, until, at the present time, the number of articles indexed by its means exceeds

by fifty per cent the number of those that were included in the International Catalogue of Scientific Literature.

S. C. BRADFORD.

Science Museum,
London, S.W.7.
Sept. 6.

Food of the Adder

IN NATURE of August 26 is a note (p. 325) on the food of the adder, in which birds are mentioned as forming part of their prey. It would be interesting to know if fully fledged birds are consumed. I do not think so, but have no positive information on the matter. As regards nestlings, however, there is no doubt that adders take these from the nest. On one occasion I was botanising in the New Forest and examining lichens on the trunk of an old white-thorn when a rustling above my head attracted my attention. Looking up, I saw a good-sized adder slipping down from amongst the upper branches, where it had been to visit a nest. I stood aside and it slid gracefully to the ground. This was in the early part of June.

On another visit to the New Forest (also in June) I noticed a small pond, considerably reduced in area by drought, in which a ringed snake (*Coluber natrix*) was moving about on the bottom *wholly submerged* hunting for food. I watched it for several minutes; then it made its way up the side of the pool and disappeared in the grass. Adders, of course, are quite often seen by pond-sides, ditches and bogs, and if they are able also to bear a certain period of total submergence it greatly extends their food-list.

The remark that "Adders are not often seen, even when looked for" would not apply generally, as some districts are much more infested than others. In the New Forest I one day counted eighteen on Black Knowl between Brockenhurst and the entrance to Queen's Bower (about three quarters of a mile). In East Devon they are frequent about the Eocene plateau (900 ft.) but when one descends to the stiff Keuper Marl they are seldom seen and the grass snake seems to take their place.

Adders rarely strike twice in succession. I have frequently put my stick on the tail of one, when it would strike at once with amazing rapidity and force, but no amount of subsequent teasing would provoke it to strike again.

G. T. HARRIS.

Buckerell,
Honiton, Devon.
Sept. 4.

Influence of Thallium Salts and Thyroid Preparations upon the Plumage of Ducks

DURING the past few years, many reports have been published relating to the influence of the thyroid hormone and thallium acetate on the moulting mechanism of feathers in birds and of hair and wool in mammals. The study of the factors underlying the exhibition of this characteristic phenomenon is not only of interest from the purely scientific point of view, but also it assumes an importance in the field of animal husbandry, particularly in those countries where the production of down and feathers from ducks and geese is a not inconsiderable industry.

With these objects in view, we have been conducting experiments with ducks, feeding and injecting preparations of the thyroid gland as well as carrying out a series of injections with thallium acetate. The activity of the thyroid preparations was determined by their power to cause metamorphosis in the tadpole.

Notwithstanding the very heavy doses employed (up to 30 gm. daily for 14 days) we have not been able to produce the shedding of feathers in any of our experimental birds. It was noted that the birds treated with thyroid showed a considerable increase in weight when compared with the birds in the control series. Systematic injections of thallium acetate resulted in death after two months, but at no time was the moulting phenomenon exhibited.

Giacomini (1930) has also been unable by thyroid feeding to produce the typical moulting of the feathers of chickens and ducks, and he has suggested that in the blood plasma of the birds used a specific substance is present which enabled the birds to neutralise the action of the thyroid hormone. It is known that young chickens are more resistant to thyroid medication than are older birds. It would seem to us, though, that the problem of the duck is somewhat different. If it could be shown that the morphology of the thyroid in the aquatic bird differs considerably from that of terrestrial forms, then at least we could attempt an interpretation of our results. An examination of the thyroid gland of the duck shows that the differences between it and the thyroid gland of the fowl are striking; in particular, we have found in the former a tremendous development of the corpuscula epibranchialia. We have not been able to find anything in the literature concerning the function of these bodies.

R. PRAWOCHENSKI.
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Zootechnical Laboratory,
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Cracow, Poland.

Process of Mutation in Resting Seeds accelerated by Increased Temperature

ON the basis of the hypothesis advanced by one of us[1] that mutation is caused by metabolic processes peculiar to ageing seeds, it was decided to test the effect of increased temperature, which it was thought might stimulate mutability by accelerating the chemical processes within the cells of the embryo. The following preliminary experiment was performed. Seeds of *Crepis tectorum, L.* (collected in 1932) were enclosed in a corked bottle (about 1 litre capacity) and placed on May 3, 1933, in an oven at a temperature of 54°–55° C. The first portion of seeds was taken for investigation on May 23 (after twenty days' treatment), the second, on June 11 (after 40 days' treatment), and the third, four days later.

The first lot of seeds germinated normally, both as regards energy and percentage of germination (the latter was so high as 94 per cent); the second lot germinated much more slowly and displayed a reduced percentage of germination (72 per cent); the germination of the third lot was the poorest, the energy being very low and the percentage of germination amounting only to 44 (in addition, some of the embryos died after having begun to break through the seed coat). All the three lots of seedlings originally had normal cotyledons, which developed chlorophyll and functioned during a whole month.

Very soon, however, striking abnormalities were observed. Most of the seedlings of the first lot

(twenty days in the oven) either were incapable of laying down the growing point or developed deficient or abnormal leaves; in the second and third lots none went beyond the cotyledon stage and all died after thirty to forty days. The development of the roots was equally affected; more than fifty per cent of the seedlings of the first lot had roots incapable of development owing to the early death of the growing point; some of them, however, developed lateral roots at a later stage. None of the seedlings of the second and third lots possessed roots capable of development.

A considerable number of the surviving young plants displayed in the course of development various abnormalities of leaf shape, etc., some later assumed a normal appearance.

Parallel experiments with X-rays have shown that an effect similar to that obtained by placing seeds in the oven at 54°–55° C. for twenty days is produced by subjecting dry seeds to a dosage of 15,000 r.

Cytological investigation of the root-tip material from the plants at the age of forty-two days revealed, according to expectation, a great number of chromosomal translocations; the mutant plants were, of course, chimæras.

The effect of moderate heat between 50° C. and 60° C. acting for twenty days upon dry seeds of *C. tectorum* thus proved to be comparable to that of ageing by keeping them at room temperature from six to seven years.

The results of this experiment clearly lead to the conclusion that heat acting upon 'resting' seeds must be an important factor in increasing the rate of mutation, both under natural conditions and in agriculture. More extensive experiments, including the study of the effect of the natural heat of the sun, are under way. A detailed report will follow.

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P. SHKVARNIKOV.

Laboratory of Cytogenetics,
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Moscow.
July 25.

[1] M. Navashin, NATURE, 131, 436, March 25, 1933.

Disappearance of *Zostera marina*

As an old student of marine biology I have read Mr. A. D. Cotton's letter in NATURE of August 19 with interest.

The reduction of growth of *Zostera marina* over such a wide geographical area is a matter of serious economic importance, and would appear to be a problem not easily solved, on account of the number of local environmental conditions requiring close attention.

In so far as the English Channel is concerned, I cannot help wondering, in the light of inshore collecting experiences during the last ten years, whether the menace of the crude oil waste from ships and motor-boats may not be a factor worth considering. From Dymchurch Bay to Looe, my experience has been that many inshore collecting grounds for marine invertebrate fauna which in pre-War days yielded an abundant supply of material, do so no longer owing to the continued growing contamination from oil waste that has taken place during the last ten or twelve years. It would be interesting to ascertain whether an appreciable amount of oil waste sludge is present in the mud on the affected *Zostera* beds, and a chemical analysis of the mud content from affected and non-affected areas might very well prove illuminating.

I know that in certain quarters opinions are sharply divided on the question of the menace from oil waste, and therefore I put forward my suggestion tentatively, but practical experience points to a growing evil.

F. MARTIN DUNCAN.

Zoological Gardens, Regent's Park,
London, N.W.8.
Aug. 19.

THE factor of crude oil waste has naturally been considered in connexion with the remarkable disappearance of *Zostera marina*, and a comparative analysis of samples of mud is being undertaken. There are three reasons, however, which render it difficult to believe that excessive oil-pollution is the cause of the phenomenon: (1) the suddenness of the disappearance of the plant over such a very wide area; (2) its *general* disappearance over this wide area irrespective of the degree of oil-pollution; and (3) the continued existence of *Zostera* beds for many years in areas believed to be heavily polluted. An instance is quoted by Dr. H. F. Lewis, moreover, of *Zostera marina* remaining unharmed in an area in the St. Lawrence where an oil tanker had been wrecked and heavy crude oil pollution occurred. It is of interest to note that in Europe, as in the United States, *Zostera nana* is still abundant and apparently quite healthy.

A. D. COTTON.

Royal Botanic Gardens,
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Aug. 31.

X-Radiation and the Allantoic Membrane of the Embryo Chick

C. M. SCOTT[1] has published a criticism of my claim of an antagonistic action of X-radiation on the allantoic membrane of the embryo chick[2]. He obtains mixed ray reactions in half an hour with a dose of 600 r. and homogeneous ray reactions in 2–3 hours with a dose of 2 r. He concludes that there is no difference in action but that the membrane reaches a critical state of sensitivity after 2 to 3 hours' exposure of the 'window' to the air.

Scott's conclusion breaks down because homogeneous ray reactions may be obtained in half an hour or less, given suitable wave-length, intensity and homogeneity. His failure to obtain results with short exposures appears to be due to the fact that he used the whole *K* spectrum of tungsten, a radiation of unsuitable wave-length and insufficient homogeneity.

Scott also claims to have obtained atrophic reactions of the allantoic membrane with feeble mixed rays. His mixed radiation, however, comprises the same spectral region as his homogeneous radiation, and as similar absorption coefficients are quoted, one must conclude that both feeble radiations are substantially the same.

W. MOPPETT.

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July 19.

[1] *Proc. Roy. Soc.*, B, **112**, 365.
[2] *Proc. Roy. Soc.*, B, **105**, 402; B, **107**, 293.

Research Items

Excavations at Kent's Cavern. At the Leicester meeting of the British Association the research committee appointed to co-operate with the Torquay Natural History Society (Sir Arthur Keith, chairman, and Prof. J. L. Myres, secretary) in investigating Kent's Cavern, reported that the excavators, Messrs. F. Beynon and Arthur H. Ogilvie, began excavations in the vestibule adjoining the northern entrance to the cavern on October 3, 1932, and on April 24, 1933, work was adjourned until the next winter season. A trench was dug, 24 ft. long by 3 ft. wide, along the eastern wall of the chamber up to the entrance door. The surface of the present floor is 5 ft. 9 in. below the level of the original granular stalagmite floor. Three other trenches at right angles to the first across the passage way were made. Bed rock was reached at a depth of 7 ft., 8 ft. and 4 ft. 3 in. proceeding inwards from the entrance. This shows that the entrance to the cave must have been at least three times the height it was when operations were begun in the last century. Specimens of the usual cave fauna were found, including the right ramus of the lower jaw of a hyæna with the condyle and lower border ungnawed, an unusual condition in Kent's Cavern. The bony base of a rhinoceros horn was also found. Artefacts included a fine bone awl and two similar, but inferior, specimens. Flint flakes and chips occurred occasionally, encouraging the hope for more finished specimens next year.

Decorated Carnelian Beads. Ancient carnelian beads decorated with designs, sometimes in white, sometimes in black, which have been found in Mesopotamia and at Mohenjo-daro, where they date from the third millennium B.C., and also in Russia, must obviously have needed skill in making. The results of inquiries made by Mr. Ernest Mackay as to the survival of the art in modern times and the technique employed are recorded in *Man* for September. It is stated that these beads are still decorated in this manner in Persia, though this has not yet been verified. Three localities of their manufacture in India are reported—Delhi, Cambay and Sehwan in Sindh; but, in fact, although carnelian is still cut—a decaying industry—painting is no longer practised as there is no demand. An informant from Sehwan had learned the art from his father, but had not practised the craft for 55 years. In a demonstration of the method formerly employed, the paint used was made from European washing soda and the juice of the macerated tips of young shoots of *Capparis aphylla*. It was applied to the carnelian with a reed pen, showing white when dry. The carnelian was fixed in a clay and cotton-wool setting, and after the paint had dried over a piece of sheet-iron on charcoal embers, was buried in the embers and the fire slowly fanned for about five minutes. The stone was then removed and polished with a rag when cool. The paint showed no permanent staining from the fumes of the charcoal. It would appear from subsequent experiment that the vegetable juice had no action other than to act as an adhesive for the paint until the soda fused, although it was found that it served to preserve the visibility of the design as the soda dried, showing white. A little carbonate of lead or any soluble lead salts produced a paint which readily adhered to the surface of the carnelian and fused quickly. Borax lowered the temperature of fusion and minimised the danger of affecting the colour of the carnelian.

Tuberculous Bacillæmia. The occurrence of tubercle bacilli in the blood in tuberculosis has been the subject of much research, and the results obtained have been conflicting. Most observers have either failed to find the bacillus, or find it very occasionally; a few, E. Löwenstein and his followers in particular, have frequently detected it not only in tuberculosis, but also in other conditions such as rheumatism. In view of these discrepancies, the literature on the subject has been critically reviewed by Prof. G. S. Wilson and collaborators, and the sources of fallacy investigated (Medical Research Council: Spec. Rep. Series, No. 182. London: H.M. Stationery Office. 2*s*. 6*d*. net). The conclusion reached is that tubercle bacilli rarely occur in the blood except in advanced pulmonary tuberculosis (5–10 per cent), or in the miliary and meningeal forms (30–40 per cent), and are non-existent in diseases other than tuberculosis. Among sources of fallacy are mentioned (1) acid-fast particles simulating the tubercle bacillus, (2) the use of old slides, blotting paper, and immersion oil, and an unwiped immersion lens, all of which may be contaminated with acid-fast bacilli from previous examinations, and (3) the assumption that colonies of acid-fast bacilli appearing in culture are necessarily growths of the tubercle bacillus. Saprophytic acid-fast bacilli are not infrequent in dust, and in tap- and old distilled water. Dr. Schwabacher found these organisms in every instance in the slime at the mouth of 56 cold-water taps examined.

Clupeoid Eggs and Larvæ from Java. Dr. H. C. Delsman continues his studies of the eggs and larvæ of fishes in his recent paper ("Fish Eggs and Larvæ from the Java Sea. (19). The Genus *Setipinna*. (20) The Genus *Coilia*." *Treubia*, vol. 14, Livr. 1, Dec., 1932). Both genera are closely related to *Engraulis*, having a protruding snout and ventral mouth. As in all clupeoids, the anus shifts gradually forward as the larva grows, the number of trunk myotomes decreasing, those of the tail increasing. In *Setipinna* and *Coilia* the anus is very far forward, especially in the latter, and the number of tail vertebræ large. As a rule, the number of trunk vertebræ slightly surpasses that of the tail vertebræ and is relatively lowest in the less slender species of clupeoids occurring nearest the coast or penetrating farthest into brackish water or river mouths. The author finds that an oil globule or several globules are present in those forms which inhabit the waters of low salinity, those farther out to sea where the salinity is higher having no oil globule. This does not agree with the British clupeoids where the pilchard, occurring furthest out, has an oil globule whilst the sprat has none. The herring, having the eggs fixed to the bottom, has no globule. The eggs and larvæ of *Setipinna* and *Coilia*, both of which inhabit waters of low salinity, are provided with oil-globules, *Setipinna melanochir* having one very large one, *S. breviceps* and *S. taty* several smaller globules. In *Coilia dussumieri*, the only species known from Java, the eggs and larvæ described almost certainly belonging to it, there are also several globules.

Discovery of Prothallus in Indian Ophioglossum. The genus *Ophioglossum* has interested a number of botanists in India and abroad on account of its peculiar systematic position in the Pteridophyta. Attempts have often been made to throw more light upon its life-history simply by the study of the sporophyte generation. But the gametophyte generation has not been so well studied on account of several difficulties. It was studied in a few species of *Ophioglossum* during the latter half of the last century and at the beginning of the present century by some eminent workers. Mettenius, for example, studied *O. pedunculosum* so far back as 1856, while Prof. Lang studied prothalli of *O. pendulum* in 1902; and Bruchmann studied *Ophioglossum vulgatum* in 1904. Later on, Prof. Campbell confirmed the results of these authors by his work on *O. moluccanum* and *O. pendulum* in 1906. Since then, no attempts appear to have been made either by way of confirmation of old results or by way of investigation of new ones. Mr. T. S. Mahabale, working under Prof. D. L. Dixit at Fergusson College, Poona, informs us that he has been able to discover the prothalli of some four Indian species which appear to be different from those studied by Prof. Lang and others. No details are given. The methods used have been summarised in a paper entitled "Rationale of the Germination of the Spores in *Ophioglossum*" which will soon appear elsewhere.

Typhoons in the Far East. Statistical information about the frequency of occurrence of typhoons in different regions of the Far East during each month of the year has recently been presented cartographically by Mr. T. F. Claxton, lately director of the Royal Observatory, Hong-Kong ("Isotyphs: showing the Prevalence of Typhoons in Different Regions of the Far East for each Month of the Year". By T. F. Claxton. Pp. 2+12 plates. (Hong-Kong: Royal Observatory, 1932)). The frequency of typhoons for the period 1884–1930, so far as it is known, has been counted for 'squares' measuring two degrees in latitude and longitude, and the figure for each square has been entered on the map for each month. The 'isotyphs' are the lines passing through squares with equal frequency, and with their aid an idea of the frequency for any part of the area dealt with could be obtained if all typhoons were observed throughout their life cycle. Unfortunately, this necessary condition has not been realised owing to the smallness of the area generally covered by a typhoon, especially in the early stages of its history; not only is this the case, but also in certain regions over the sea which are not frequently visited by ships, the chance of a typhoon being seen and reported must be relatively small. There is accordingly a systematic distortion of the isotyphs that the length of the period covered has done nothing to remove. This, of course, is no fault of Mr. Claxton. Our knowledge of tropical cyclones throughout the world is similarly distorted simply because they are mainly marine phenomena and for the most part occupy areas for which weather reports are scanty. The method of representation followed by Mr. Claxton is effective apart from the drawback to which attention has been directed, and has resulted in a concise picture of the statistical matter under consideration that should be of value to captains of ships navigating these waters and to students of this type of storm.

Ionisation by Positive Ions. R. M. Chaudhri has recently described (*Proc. Roy. Soc.*, A, August) a method of studying ionisation of gases by positive ions. Electrons are formed in such experiments not only by gaseous ionisation but also by bombardment of metal surfaces, and these electrons have complicated the interpretation of previous work. In the Chaudhri apparatus a narrow beam of positive ions is sent between the plates of a parallel plate condenser containing a gas at low pressure. The electrons formed are drawn out by a transverse electric field. Their velocities are then analysed in a magnetic field. The electrons formed by gas ionisation fall through about half the total potential difference, and form a group distinguishable from the stray secondary electrons. The gas pressure is so low that the secondary electrons themselves do not produce appreciable ionisation between the plates. It was found that mercury vapour was ionised by Hg^+ ions with energies down to 700 volts, and by K^+ ions of 1,600 volts. The efficiency of ionisation was much higher for the Hg^+ ions than for the K^+ ions.

A New Pattern Hygrometer. Particulars have been received from Messrs. A. Gallenkamp and Co., Ltd., 17–29 Sun Street and 1–3 Clifton Street, Finsbury Square, London, E.C.2, of a new pattern of hygrometer. A sensitive absorbent fibre is used in place of the usual hair of the hair hygrometer, and it is claimed that by this means the need for frequent adjustment is avoided. A pointer connected with the fibre registers percentage relative humidity on a graduated dial. The instrument is designed primarily for use in factories and can be provided with a folding pocket whirler with the aid of which an accurate reading can quickly be obtained on passing from a room of very low to one of very high humidity, or vice versa, but when used out of doors whirling is unnecessary, and it can then be mounted in a special small louvered protecting screen. The pocket model has a ventilated copper bronze case $2\frac{1}{2}$ inches in diameter and $\frac{3}{4}$ inch thick, of sufficient strength to allow of its being placed between reams of paper or bales of soft material when determining the humidity of the enclosed air. The pocket model is listed at 15*s.*, the pocket whirler at 5*s.* 6*d.* and the special screen for outdoor use at 24*s.*

Spectra of Novæ. Harvard Reprint 95 contains a new theory of the behaviour of novæ by Menzel and Miss Payne originally published in *Proc. Nat. Acad. Sci.*, 19, 641; 1933. It has hitherto been supposed that a nova outburst begins with the expansion of the star as a whole, and that the star ejects a shell of nebulous matter, and then contracts and grows fainter. Menzel and Miss Payne suppose that the expansion is confined to the photospheric layers, which are blown away from the stellar surface at the first outburst. The star then becomes a sort of planetary nebula. The observed progression of the nova spectrum from an absorption spectrum to a bright line spectrum which develops nebular lines supports this view. The authors tabulate the order of appearance of the lines in Nova Persei, Nova Aquilæ, and Nova Pictoris, the excitation potentials and other characteristics of the lines being noted. They find that the bright line spectra of novæ can be interpreted in terms of rapidly rising temperature, rapidly falling pressure and rapidly increasing dilution of radiation.

A Sound Track of the Vowel *ah*

By PROF. E. W. SCRIPTURE

THE sound track in the accompanying illustration (Fig. 1) is a registration of the vowel *ah* (wire loop oscillograph on a sound film). The track reads from left to right. It is marked off into short bits by sharp upward jerks. Such a portion we will term a *vowel bit*. Each vowel bit comprises a sharp upward vibration followed by a complicated up and down movement of rapidly fading amplitude. It shows the characteristic curve of a heavily damped free vibration of a system aroused by a momentary impulse and then left to itself. It is the registration of the vibration in the vocal cavity aroused by a sudden puff of air from the glottal opening. The puff of air itself is a mass movement of air that is dissipated just outside the mouth. It is not propagated and it cannot be registered by use of a microphone; it does not appear in the sound track.

The profile of a vowel bit—its sound curve—is determined by the size, shape and openings of the vocal cavity. The strong damping arises from the softness and moisture of the walls. The profile of form may be more or less irregular, but at any rate it shows up and down movement. We then count the number of such up and down movements in the profile. In the first vowel bit it is four with a lot over, in the second bit four with not so much over, and so on. We may term the frequency of this up and down movement the lowest vibratory number. We find that it never stands in the relation of 1, 2, 3, . . . to the frequency of the bit, that is, it is never harmonic to it. A peculiarity of this slowest vibratory movement is that it changes its period within the vowel bit. This indicates a continual change in the vocal cavity.

With less smoothing of the profile we get indications of vibratory movements of higher frequency. The many fine points indicate that there are very many vibratory movements of decidedly high frequencies. At present we can get at these frequencies only by measuring the distances between the points.

Just before the first upward jerk in Fig. 1 there are small vibrations of a semi-regular kind. They much

FIG. 1.

each bit is similar to but not exactly like that of the preceding one. This indicates that the vocal cavity is continuously changing its size, shape and openings.

When a noise such as that produced by a card as it snaps from one tooth to the next of a revolving toothed wheel is repeated with sufficient rapidity, a tone is heard. The tone is a new sensation added to the series of snaps; it has no physical existence. It is the mental correlate of a number, namely, the frequency of the snaps. When a short bit of vibration from a fork is repeated with sufficient rapidity, two tones are heard. One is that of the fork; its pitch remains constant. The other is that due to the repetition of the bits; its pitch rises or falls according to the frequency of repetition. The repetition of the vowel bits produces a sensation of tone that rises and falls with the rapidity of repetition. This is known as the voice tone. The voice tone is the mental correlate of the frequency of repetition; it has no physical existence. Since each vowel bit is the result of a jet of air from the glottis, the frequency number refers to the series of glottal jets also. Psychologically we speak of a voice tone; physiologically we speak of a laryngeal frequency.

We must now find numbers with which to characterise the vowel profiles. The Fourier analysis has failed us[1]. As a first attempt we may suppose the little variations to be smoothed off and the fine depressions to be filled up; that is, we 'sandpaper' the curve until it shows only a simple form. The resemble the vibrations that appear in tracks for *h*. We can attribute them to the rush of air through the glottal opening before it closes to produce the first jet. This preliminary noise is much too brief to be perceived. If made longer it would be noticed as an *h*. The Cockney makes the preliminary noise so strong that other persons hear it as an *h* although he himself does not notice it. The preliminary noise is much weaker in English than in American. This explains why an Englishman not only says and writes 'ostler' but even writes 'an hotel', while an American says and writes 'hostler' and 'a hotel'.

Such a complicated curve as that of the profile of a vowel bit cannot be adequately expressed by one or two frequencies; they will rather have to be produced in tens, and many numbers must be added to express the damping. Such complication is what would be expected when we consider that a profile registers not only the linguistic characteristics of what was said but also the peculiarities of the speaker. What we have to understand by the last expression may be indicated by the following facts. We can recognise individuals by the manner of speaking a vowel; in fact, each vowel bit includes the voice signature of the speaker. The sound changes with every shade of emotion and thought. It alters according to the condition of health and disease. It is different with every difference in the vocal organs. The very character of the speaker is felt by the timbre of his voice. All this and much more information lies before the eye in the sound tracks. Unfortu-

nately, we have not yet advanced much in finding a method of getting at it.

Incidentally the vowel track disposes of the overtone theory of the vowels. No vibration whatever is present with a period of the length of a vowel bit or of half of it or of one third of it or of any other harmonic. The vocal cavity resonates to a Jew's harp because it has a source of vibration to resonate to. It cannot resonate to the jets of air from the glottis because they are mass movements that can arouse vibrations but are not vibrations themselves. In passing, it may be noted that the name of Helmholtz is incorrectly associated with this theory. Helmholtz himself rejected it[2].

[1] NATURE, **130**, 965, Dec. 24, 1932.
[2] "Lehre v. d. Tonempfindungen", p. 197.

Spectroscopy Conference at Cambridge, Massachusetts

MORE than a hundred scientific and industrial spectroscopists gathered in the new George Eastman Research Laboratories at the Massachusetts Institute of Technology during the week of July 17–22 at a conference which dealt with all aspects of their subject from spectrochemical analysis to atomic structure. At the meeting on July 17, half-hour papers on various aspects of quantitative spectroscopic analysis of materials were presented by C. C. Nitchie, of the Bausch and Lomb Optical Co., W. F. Meggers, of the Bureau of Standards, C. E. K. Mees, of the Eastman Kodak Co., F. Twyman, of Adam Hilger, Ltd., and Keivin Burns, of the University of Pittsburg. A report by D. M. Smith on research on metallurgical applications of the spectrograph to non-ferrous metals and alloys was read by Mr. Twyman.

This discussion was continued at informal meetings specially arranged for July 18 and 20, and much interest was shown in the possible applications of the spectroscope to industry brought out by the various speakers. The first of these sessions was devoted to biological and chemical applications of spectroscopy, papers being given by W. A. Noyes, Jr., of Brown University, G. S. Forbes and G. B. Kistiakowsky, of Harvard, F. Twyman, and Keivin Burns.

On July 18 the members of the conference were invited to inspect the Harvard Observatory and were entertained at tea by Director and Mrs. Shapley. The morning session of July 19 was devoted to papers on physical and astrophysical aspects of spectroscopy, given by D. H. Menzel, of Harvard, G. H. Dieke, of Johns Hopkins, F. Twyman, W. W. Watson, of Yale, and F. H. Crawford, of Harvard. In the afternoon the conference adjourned to the Round Hill Experiment Station at South Dartmouth, Mass., where members were entertained with a demonstration of one portion of the Van de Graaff 10,000,000 volt generator now approaching completion.

On July 20 the analysis of complex spectra was discussed by A. G. Shenstone, of Princeton, J. E. Mack, of the University of Wisconsin, W. F. Meggers, G. H. Dieke, and Keivin Burns. In the afternoon a visit was paid to the Harvard Physical Laboratories. Two sessions were held on July 21, that in the morning being devoted to spectroscopy and atomic structure, with papers by E. U. Condon, of Princeton, G. R. Harrison and J. C. Slater, of the Massachusetts Institute of Technology, and D. R. Hartree, of the University of Manchester, while at the afternoon session on hyperfine structure and related topics contributions were made by J. Wulff, of the Massachusetts Institute of Technology, A. Ellett, of Iowa State University, G. Breit, of New York University, and R. C. Gibbs, of Cornell.

Exhibits of modern types of spectroscopic apparatus were arranged in the Spectroscopy Laboratory of the Institute by a number of manufacturers. The average attendance at the meetings throughout the week was more than eighty, including a number of Canadian and British spectroscopists.

Chemical Control of the Circulation

THE discussion on this subject in Section I (Physiology) on September 11 at the meeting of the British Association was opened by Sir Henry Dale, who gave a valuable historical summary of its development. He pointed out that of the many different substances having an effect on the blood vessels, the only two which can be regarded as true hormones, having a general as distinct from a local effect, namely, adrenaline and vasopressin, are predominantly pressor in action, whereas substances acting locally are vaso-dilator. He described the discovery of acetyl choline and histamine and discussed further recent evidence that histamine is liberated in anaphylactic shock.

Feldberg has shown that when the fluid perfusing the isolated lung of a guinea-pig rendered anaphylactic to egg albumen is passed in turn through the lung of a normal guinea-pig, the production of anaphylaxis by the sensitising antigen in the first lung is attended by constriction of the bronchioles in the second lung. Sir Henry then showed how the triple response of the reaction of the skin to injury described by Lewis is fully explained by the liberation of histamine at the site of injury, causing a flush in the immediate neighbourhood and a diffusion of fluid, while as a result of an axon reflex to the arterio-dilator branches of the sensory fibres, acetyl choline is liberated causing a more distant area of flare.

Dr. A. N. Drury developed the account of local vaso-dilator substances by describing the action of adenylic acid which, jointly with Prof. Szent-Györgyi, he isolated from muscle; he has found evidence that a second depressor substance may be cytidylic acid. The liberation of adenylic acid can be demonstrated by its production of heart block in the guinea-pig's heart, and Dr. Drury has found that it is liberated when muscle is injured, as by burning; he thinks it unlikely that adenylic acid plays any part in the dilatation of vessels accompanying muscle activity. He has found that adenylic acid causes a migration of leucocytes, and leads to pus formation in the eye; he pointed out that the action of histamine and acetyl choline cannot account for the whole of the reaction of the skin to injury, since histamine has no effect on leucocyte migration, though this certainly takes place as part of the reaction.

Mr. J. H. Gaddum gave an account of the reactions of two other vaso-dilator substances of unknown composition. One is called 'kallikrein' by its discoverers, Kraut and Frey; it is said to be formed by the pancreas and liberated in the blood stream in an inactive form. It becomes vaso-dilator by an increase in the hydrion concentration. The other substance is known as *P*-substance, and causes a fall in blood pressure in the atropinised rabbit, and is present in intestine and brain.

Prof. J. H. Burn described experiments indicating the effect of adrenaline on the response of the blood vessels to other substances. When a substance like tyramine, which in the animal is powerfully vaso-constrictor, is injected into the limb vessels of a dog perfused with defibrinated blood, it is found to have very little constrictor action; the same is true of ephedrine. The normal vaso-constrictor effect is only seen when adrenaline is steadily added to the blood perfusing the vessels so as to maintain a concentration for a period of time. Similarly, sympathetic stimulation is relatively ineffective in the perfused preparation in the absence of adrenaline. Vaso-dilator responses to injections of ephedrine and to sympathetic stimulation also appear in the presence of adrenaline. Prof. Burn discussed the relation of these observations to the recent work of Cannon and Rosenblueth, which indicates that different substances are released when motor and inhibitor sympathetic fibres are stimulated; these substances are thought to be combinations of adrenaline with other substances, so that one combination causes only motor sympathetic, and the other only inhibitor sympathetic effects.

Dr. W. Feldberg described experiments showing that when the splanchnic nerves to the suprarenal glands are stimulated, the liberation of adrenaline in the blood is secondary to the liberation of acetyl choline; the demonstration of the presence of acetyl choline is rendered easy by the injection of eserine, which paralyses the esterase normally responsible for the destruction of acetyl choline in the blood. If a cat be given sufficient ergotoxine to paralyse the action of adrenaline on the salivary gland, stimulation of the splanchnic nerves in the presence of eserine will produce a rapid flow of saliva. Since the suprarenal is morphologically equivalent to a sympathetic ganglion, then, as Sir Henry Dale pointed out, the transmission of an impulse across a sympathetic ganglion may be due to the liberation of acetyl choline.

Dock and Wharf Lighting*

THE labourers employed in docks and factories sometimes run serious risks of bodily injury owing to defective lighting, which also slows down their work. It seems to us that some of the suggestions made in the report on the lighting of docks recently issued by the Department of Scientific and Industrial Research, would, if universally adopted, greatly reduce these risks at a negligible cost.

In order that an obstacle may stand out conspicuously, even with high illumination, it is necessary that it should have some feature which contrasts with the background. To obtain this, it is recommended that all quay and lock edges should be whitened by means of a special cement wash. For objects near the water's edge, painting with alternate black and white rings is suggested. Owing to the dark and dirty nature of the paving stones on quays, a fairly high order of illumination is required but where cranes are used, overhead lights must not be too bright as the glare prevents swinging loads from being clearly visible.

In all places where there is an element of danger, such as where railway tracks are in close proximity to roads or footways, it is advised that a minimum illumination instead of an average illumination should be specified. In this case high mounted fittings with a definite cut-off give very little glare and do not cast sharp shadows. The very appreciable improvement effected by whitening the interior of a dock warehouse is strongly recommended. The contrast between modern scientific lighting and the somewhat haphazard methods of the past is emphasised by the photographs reproduced.

The use of flood lights on high standards is advised in all cases where minerals in bulk are dealt with, or where the material is of considerable size, for example, steel rails and girders. Granaries require special treatment on account of obstruction by machinery or shoots hanging from above. One method is to use a large number of low power frosted lamps without any special fittings. Diffusion from the light-coloured dust produces an effect which increases the illumination. In the case of coal handling plant, an abnormally high illumination is required because of the low reflecting power of the coal, and flood lighting is recommended.

The report, which is by J. S. Preston of the National Physical Laboratory, contains an outline of the principles of illumination which will prove helpful to engineers.

* Department of Scientific and Industrial Research. Technical Paper, No. 14: Industrial Lighting. Part 1: Docks, Warehouses and their Approaches. Pp. iv+34+4 plates. (London: H.M. Stationery Office. 9*d*. net.)

University and Educational Intelligence

CAMBRIDGE.—The John Winbolt prize awarded for an exercise on some subject related to the profession of a civil engineer has been awarded to P. A. Lamont (Stockport Grammar School and Corpus Christi College) for a dissertation on "The Stresses and Deformations in Retaining Walls of Triangular Section".

IT is announced in *Science* that Prof. George Barger, professor of chemistry in relation to medicine in the University of Edinburgh, is to receive the honorary degree of LL.D. of the University of Michigan on September 25.

MR. GEORGE B. KARELITZ, manager of the marine engineering division of the Westinghouse Electric and Manufacturing Company, South Philadelphia Works, has accepted the chair of mechanical engineering in Columbia University. Mr. Karelitz intends also to engage in consulting practice in order to maintain close contacts with industry.

THE Mexican rural school system, inaugurated in 1920, has been studied at first hand by a member of the staff of the United States Office of Education whose report (Official Bulletin, No. 11, 1932) shows that this interesting experiment has achieved a considerable measure of success. Eighty per cent of the population are rural, growing their own food and making with their own hands the other necessaries

of life and cherishing their inherited Indian traditions. Dr. Moisés Saenz who, as sub-secretary of the Federal Office of Education, played an important part in the experiment, has told how missionaries were sent to preach from village to village throughout the country "the gospel of the new schools". As a result of this campaign and of a policy of local option and self-help and choosing teachers from among the natives of the district served, the wholehearted co-operation of the local community was secured. The zeal and vision which marked the establishment of the schools are perpetuated by a unique agency known as "Las Misiones Culturales". Each mission, composed of some half-dozen specialists in agriculture, small-scale industries, popular arts, physical training, nursing and community organisation, is a peripatetic normal school, holding each year about ten thirty-day courses in as many different centres for all the rural school teachers within a radius of about fifty miles from each centre, and combining with the training of teachers a campaign for the promotion of better farming, better crafts and arts, better health and better standards of living. The close of the course is celebrated by a festival on a grand scale comprising a fair with games, dances, dramatic performances, agricultural shows and demonstrations foreshadowing some of the features of the ensuing year's school programme.

Calendar of Nature Topics

Equinoctial Gale

The belief that a violent storm is to be expected when the sun crosses the equator about September 22 goes back at least to 1748, and is held both in England and the United States. Its origin is not known but it may have been coined by sailors from experience of the West Indian hurricanes, which are especially frequent about this date. Statistics of gale frequency show that in England there is no especial tendency for storms to occur near the autumnal equinox ; on the contrary, they increase steadily in frequency from summer until mid-winter. The autumnal equinox may, however, be regarded as the conventional beginning of the winter or stormy season. The belief in an equinoctial gale is sometimes extended to the spring equinox, March 21, but for this there is no basis at all.

Hibernation of American Ground Squirrels

The shortening of the day, bringing a reduction of temperature particularly noticeable during the lengthening night, is accompanied by a gradual falling off in blossoms and foliage, and this in its turn by a disappearance of insect life. So are brought into action the devices adopted by creatures hard-pressed by lack of food and by cold—migration on land and in the sea, the seeking of sheltered nooks or nests, the curious adaptation of hibernation.

Early in September many of the ground squirrels (*Citellus*) of North America disappear into their winter quarters and there they may remain during an unbroken period of activity for more than seven months. The time of retiral is associated with vegetational changes, for the squirrels become very fat, and the increase of weight, which is very small during the spring and early summer, becomes marked when grain and seeds are filled and ripening. With the fatness comes a tendency to become lethargic and this is associated (contrary to proverbial humanity) with increased irritability, and with a drop in body temperature to below 30° C. in warm or cold environments. The lethargic state precedes profound torpidity which supervenes on the coming of cold weather. On waking after the period of hibernation, the squirrels may have lost a third to a half of the body weight with which they retired.

Experiments on Hibernation of Ground Squirrels

In order to investigate the causes which start hibernation, Otis Wade made many experiments with ground squirrels (*J. Mamm.*, 11 ; 1930). He found that hibernation took place equally well in rooms with a high relative humidity or with very dry air ; some have hibernated in well-lighted rooms, some have remained active in dark rooms ; some have become torpid in well-ventilated rooms ; some have hibernated when abundance of food was present. Indeed, so anomalous appears to be the onset of hibernation that squirrels kept in a darkened cold room in midwinter and deprived of all food for three weeks have not hibernated. But should a squirrel remain active during the hibernating season, whether in a cold or warm environment, either dark or well-lighted, and with ample food present, it will show a decided tendency to lose weight, and will consume less food than during the spring and summer—a result apparently correlated with the loss of appetite which normally takes place at the commencement of the usual season of hibernation.

Active ground squirrels have a range of body temperature of 9° C., but when their temperature falls below 30° C., they always show symptoms of lethargy. In full torpidity they lie in a rolled-up position, with the head tucked away towards the rump, and then respiration and circulation are greatly slowed down and the power of temperature regulation is in abeyance, so that the body temperature varies with that of the air down to a minimum of 3·5° C. Beyond this, a rapid drop of air temperature to −1° or −2° C. wakens most hibernating squirrels, but not all, for some may die when exposed to freezing temperatures without ever arousing from torpidity.

Productivity of Pasture

The level of production of pasture is far from uniform throughout the year, and even in the humid climate of Great Britain, rainfall is one of the main factors controlling the quantity of grass available. Lack of moisture seldom interferes with the early summer flush when bulk and quality occur together. So rich is the herbage in protein at this time that if a supplement must be fed, as for example to high yielding cows, it should be of a carbohydrate character. When a dry summer follows, as in the present year, yields fall off very seriously and succulent fodder crops form a useful addition to the burnt up pastures. A second flush occurs when the rain comes, but late growth is well recognised as being less valuable to the grazier than spring grass. The difference is not entirely accounted for by differences in chemical composition of spring and autumn grass, but the quantity available, the length of grazing day, and the prevailing temperature, are all in favour of the spring grazing. The final result is that autumn grass must be helped out by concentrates of a more balanced character than the carbohydrate diet appropriate to young spring grass.

Societies and Academies

LONDON

Institute of Metals (Silver Jubilee Autumn Meeting at Birmingham), September 18–21. N. AGEEW and D. SHOYKET: Constitution of the silver-rich aluminium–silver alloys. The constitutional diagram has been determined by micrographic examination, X-ray analysis, and hardness measurements. The β′-phase (Ag_3Al) is converted on heating above 400° C. into a mixture of α and γ. The α- and γ-phase boundaries at high temperature have been determined by precision measurements of the lattice parameter and by micrographic examination of the quenched alloys. The β-phase is stable only at high temperatures, and below 600° C. is converted into the α + γ eutectoid. W. E. ALKINS and W. CARTWRIGHT: Experiments in wire-drawing. (3) Annealing of H.C. copper wires drawn to varying degrees of hardness. The annealing behaviour depends not so much on the original tensile strength of the wire as on the amount of reduction by cold-work which it has undergone. The more lightly drawn wires show an appreciable increase in strength after annealing at low temperatures. They retain their strength at temperatures up to, say, 250° C., very much better than the harder wires; the latter begin to soften at temperatures little above 100° C., and the rate at which strength is lost increases with increasing cold-work. After all heat-treatments of sufficient severity to effect more or less 'complete' annealing, the breaking load is lower the less the amount of cold-work done on the wire, and it increases steadily with increasing cold-drawing until the three most severely drawn wires of all are reached, when there are fairly definite indications of a decrease in the strength of the fully annealed wire. N. P. ALLEN: Distribution of porosity in aluminium and copper ingots, with some notes on inverse segregation. In three copper ingots and four aluminium alloy ingots cast in a specially tapered mould, the distribution of porosity followed the probable form of the isotherms in the cooling mass, and was much influenced by the mould taper. The type of micro-structure also had an influence on the distribution of porosity. The inverse segregation of two aluminium-copper alloy ingots was closely related to their porosity. G. D BENGOUGH and L. WHITBY: Magnesium alloy protection by selenium and other coating processes (2). Small losses of weight of Elektron alloy AZM (sheet) resulting from corrosion by immersion in, or spraying with, sea-water are associated with serious losses of elongation. Visual inspection did not suggest the extent of the damage, which occurred even when the alloy was protected by chemical coatings and paint. H. W. BROWNSDON, MAURICE COOK and H. J. MILLER: Properties of some temper-hardening copper alloys containing additions of nickel and aluminium. When nickel and aluminium are present in certain quantities and ratios, the alloys are softened by quenching from relatively high temperatures, and the quenched alloys, both in the soft and cold-worked conditions, harden considerably when reheated or tempered to an intermediate temperature somewhat below the annealing temperature. H. J. GOUGH and D. G. SOPWITH: Corrosion-fatigue characteristics of an aluminium specimen consisting of two crystals. The specimen was tested under alternating torsional stresses in a slow stream of tap water. The intercrystalline boundary was not attacked by the corrosive medium, nor did it influence in any visible manner the method of failure of the specimen, which took place primarily by the formation of cracks in areas undergoing heavy plastic deformation. On the surface of the specimen these cracks were generally parallel to the traces of the operative slip-planes; in several cases they had their origin at holes situated in the most highly stressed regions; of the origin of these holes no definite evidence is available.

(*To be continued.*)

PARIS

Academy of Sciences, August 7 (*C.R.*, 197, 433–468). CHARLES RICHET: The hereditary stability of acquired characters. With reference to the work of Costantin and of Schübeler on the permanent changes produced in cereals by cultivation at high altitudes, the author recalls his work on the lactic bacillus, from which similar conclusions can be drawn. C. CAMICHEL, L. ESCANDE and E. CRAUSSE: The similitude of mobile barrages. An experimental comparison between weir flow at the Gentille works and on a reduced model, scale one-tenth. HENRI JUMELLE: The palm trees of Madagascar. ANDRÉ LABARTHE: The direct determination of mean pressure in thermal machines. A. KASTLER: The polarisation of fluorescent light of pure mercury vapour. D. CHALONGE and MLLE. L. LEFEBVRE: The prolongation of the ultra-violet absorption spectrum of ozone towards greater wave-lengths. Study of the ultra-violet absorption spectrum of ozone in the ultra-violet for wave-lengths between 3385 A. and 3660 A. The length of the ozone column was 245 cm. and the concentration of the ozone of more than 20 per cent. JEAN THIBAUD: The electrostatic deviation and specific charge of the positive electron. Experimental studies on the deviations of a stream of positive electrons produced in magnetic and electrostatic fields. MLLE. M. L. JOSIEN: The action of chlorine water on silver nitrate. Kinetic study. From a mixture of chlorine water and silver nitrate solution there is an immediate precipitation of one half the chlorine present as silver chloride. There is afterwards a slow decomposition of hypochlorous acid, with a further precipitation of silver chloride, five-sixths of the chlorine present being finally precipitated. PIERRE JOLIBOIS: The graphical representation of chemical equilibria. Remarks on a recent note on this subject by Etienne, claiming priority. PICHOT: The action of electrolytes on solutions of kaolin. Curves are given showing the effects of changes in the variables, nature of electrolyte, concentration of electrolyte, age of the colloidal solution of kaolin, opacity. PIERRE TRUNEL: Some nitriles and ketones of bromo fatty acids. J. GUBLER: The age of the eruptive series of southern Indo-China (Cambogia and Cochin China to the west of Bassac). LOUIS DUBERTRET: The structure of the eastern coast of the Mediterranean. A. DORIER: The larvæ of *Parachordodes violaceus*. This larva possesses specific morphological characters, allowing it to be easily differentiated from the known larvæ of other Gordiaceæ. In its latent life, it remains alive in moist air for several months, and this supports the hypothesis of a possible direct infection of terrestrial Coleoptera. BUNZÔ HAYATA: Some interpretations of the chromatic reduction. BLARINGHEM: Remarks on the preceding communication.

August 16 (*C.R.*, **197**, 469–500). HELMUT HASSE : The theory of normic remainders in Galoisian extensions. TORSTEN CARLEMAN : Linear systems of partial differentials of the first order with two variables. SILVIO MINETTI : The geometry of the holospace of holomorph functions in a given domain and its connexions with the theory of ordinary differential equations. F. DE KOK : Some properties of a function with a real positive part. TCHANG TE-LOU : An abnormal regime of working of internal combustion motors. ERRERA and H. BRASSEUR : The specific inductive capacity of the water of crystallisation of alums. The results of measurements of eight alums are given : it would appear that the dielectric constant is a measure of the force with which the water of crystallisation is retained by the solid. CONSTANTIN HRYNAKOWSKI and CASIMIR KALINOWSKI : The association of some derivatives of salicylic acid and the deformation of their molecules deduced from measurements of the molecular dielectric polarisation. GEORGE F. JAUBERT : Respiratory apparatus making use of alkaline peroxides (oxyliths). A table is given showing the amounts of oxygen developed by the various peroxides proposed for use in this class of apparatus. It is pointed out that the nature and mode of incorporation of the catalyst used in addition to the peroxide is of importance. D. SCHNEEGANS : The subdivision of the Flysch zone to the south of the Maurienne. ROGER LAMBERT : Geological observations in the region between Agadez and Zinder (Niger). MLLE. FRANCOISE BLOCH and LOUIS GALLIEN : A copepod parasite of the eggs of *Carcinus mœnas* (*Lecithomyzon mœnadis*). CH. JOYEUX and J. G. BAER : The re-encapsulement of some larvæ of cestodes. GEORGES BLANC, M. NOURY, M. BALTAZARD and MLLE. FISCHER : The presence in the louse of the Getulie squirrel of a recurrent virus of the Spanish-African type, pathogenic for man and for the guinea-pig. WEINBERG : Serotherapy of gangrenous appendicitis and of peritonitis. Statistical summary showing the reduced mortality due to the use of antigangrene and anti-colibacillus sera.

CRACOW

Polish Academy of Arts and Sciences, May 1. A. PIEKARA : The dielectric polarisation of mixtures of nitrobenzene and hexane. The polarisation in the neighbourhood of the point of separation of the phases. S. MROZOWSKI : The depolarisation produced by the addition of helium to the fluorescent vapour of iodine. LESTER STROCK : The crystallographic and optical study of nitropentamine-cobaltic chloride. Summary of the results of work on the crystals of $[CoNO_2(NH_3)_3]Cl_2$. L. MARCHLEWSKI and W. URBANCZYK : The absorption of the ultra-violet rays by certain organic substances (30). From a study of the absorption spectra of solutions of arabinose and rhamnose to which increasing amounts of sodium hydroxide have been added, the authors conclude that the selective character of the absorption of the ultra-violet rays in sugars is caused by a change from the original cyclic constitution to that of the aldehydic type. P. PAWLOWSKI : Studies on the delphiniums of central Europe belonging to the 'Elatopsis Huth section' (1). The author does not agree with the classification now accepted and suggests a division into two series, especially those of *Montana* and *Elata*. W. FRIEDBERG : *Oncophora dubiosa* (*O. gregaria*) in the Miocene of Poland. L. MONNÉ : Researches on the spermogenesis of *Tethys leporina* and of some other gasteropods. ST. MARKOWSKI : Contribution to the knowledge of the development of the larva *Tetrathyridium variabile*.

MELBOURNE

Royal Society of Victoria, May 11. W. A. OSBORNE : So-called reversible hæmolysis. This varies greatly with different bloods. A good method is to take fresh defibrinated dog's blood and lake with double quantity of water, then add sufficient salt to re-establish osmotic pressure, and turbidity appears. It is an osmotic phenomenon as it is given by organic bodies such as glucose and glycerine. It is not given by urea. The gradual disappearance of the turbidity is difficult to explain. W. H. NICHOLLS : Three species of the genus *Prasophyllum*, R. Br. Deals with the forms grouped under *Prasophyllum fuscum*, R.Br. which includes (1) the type form from Port Jackson, (2) *P. alpinum*, R.Br. (*P. tadgellianum*, Rogers) and (3) the form known as *P. fuscum* in South Australia which is distinct from both and here described as a new species, *Prasophyllum pallidum*.

VIENNA

Academy of Sciences, June 16. RICHARD WEISS and KARL BLOCH : The reactions of *o*-phenylene-bis-(phenylglyoxal) and the retro-benzylic acid rearrangement : preparation of 2 : 3-diphenyl-1 : 4-dioxynaphthalene. ANTON KAILAN and SIMCHE SCHWEBEL : Esterification velocities of alcohols in acetic acid (2). The esterification velocities of a number of alcohols dissolved in acetic acid have been determined from the velocities of increase of the freezing point depression. A double linking or a phenyl or nitro group in the alcohol diminishes the velocity most when nearest to the hydroxyl group, but less in the second nearest than in the third nearest position. Solutions containing 0·15–0·3 mol. of the alcohols per kilogram of acetic acid show molar freezing point depressions of 2·98°–3·77°, but for equally concentrated solutions of the acetic esters the almost constant value 3·79° is obtained. OTTO BRUNNER, HANS HOFER, and ROSA STEIN : Amyrins (3) : constitution of sapotalin and of the hydrocarbon $C_{14}H_{16}$. Oxidation of sapotalin, obtained by dehydrogenation of amyrins by means of selenium, gives a quinone, which may be converted into 3 : 4-dimethylphthalic acid. The constitution of sapotalin as 1 : 2 : 7-trimethylnaphthalene is thus confirmed. The hydrocarbon, $C_{14}H_{16}$, which gives mellophanic acid as sole oxidation product, is 1 : 2 : 5 : 6-tetramethylnaphthalene. ERNST BEUTEL and ARTUR KUTZELNIGG : Sorption of iodine vapour by certain inorganic substances. Zinc oxide obtained by heating the basic carbonate at 300° absorbs iodine vapour with avidity and becomes deep reddish-brown. This colour is regarded as a transparence colour of a thin iodine film, modified by the optical behaviour of the sorbent. Within limits, the iodine content is related linearly to the logarithm of the proportion of light reflected. STEPHAN PELZ : The crystal photo-effect of coloured rock-salt. Illumination of a narrow strip of a rock-salt crystal, coloured by exposure to radium and placed between two electrodes, one earthed and the other connected with a Wulf filament electrometer, generates a current owing to diffusion of electrons from the illuminated to the non-illuminated portion of the crystal. For low intensities of the light, the current is proportional to the intensity, but not to the total energy absorbed.

ILSE MERHAUT and HELMUT WALLNER: Abnormal scattering of α-particles at heavy metals. GERHARD KIRSCH and HERTHA WAMBACHER: Velocity of neutrons from beryllium. Neutrons emanating from beryllium consist of a number of groups of neutrons with similar velocity, each position of excitation corresponding with several neutron velocities. Fifteen of these velocities have been observed and found to be distributed moderately regularly over the interval $1-5\times10^9$ cm. per second. KARL PRZIBRAM: (1) Recrystallisation and coloration (4). Retardation of the recrystallisation of pressed potassium bromide crystals by exposure to radium affects only nucleus formation and not growth of the grains. (2) Plasticity and hardness of alkali halide crystals. Determinations of the plasticity coefficient *b* (previously defined) and of the Brinell hardness have been made for sodium bromide and iodide and potassium iodide. For one and the same cation, *b* is, as a first approximation, a linear function of the lattice constants. ANTON SKRABAL and ALFRED ZAHORKA: Velocity of hydrolysis of the simple ethers. The velocities of hydrolysis of diethyl, ethyl isopropyl, and di-isopropyl ethers at 55°–95°, with *p*-toluenesulphonic acid as catalyst, are in the ratios 1 : 10 : 33. For diethyl ether the half-life period is 90,300 years at 25°, this being the slowest acid hydrolysis yet measured. For the mixed ethyl isopropyl ether, the constant lies between the geometrical and arithmetical means of the values for diethyl and di-isopropyl ethers. ANTON SKRABAL: Calculation of the reaction velocity as a function of the temperature. A method is given for calculating the constants of velocity-temperature functions which obviates the disadvantages of the least square or approximation methods. A. FRIEDRICH: Fission of glucose by alkali in an atmosphere of nitrogen. The action of alkali on glucose is accompanied by formation of acid and in its first stage seems to be a molecular reaction between one molecule of alkali and one molecule of the sugar. With excess of alkali and continued heating the consumption of alkali increases somewhat. The acids produced comprise formic, acetic and glycollic, and the aldehydic or other derivatives separable as hydrazine compounds are mostly 4- or 5-carbon atom compounds.

Forthcoming Events

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

Thursday, September 28

INTERNATIONAL FEDERATION OF EUGENIC ORGANISATIONS, at 8—(at the Royal College of Surgeons, Lincoln's Inn Fields, London).—Prof. Hans Maier: "Some Aspects of Sterilization in Switzerland" (in English)*.

Saturday, September 30

SCHOOL NATURE STUDY UNION, at 2.30–6.—Bi-annual Nature Study Exhibition at the Institute of Education, Southampton Row, W.C.1.

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 7, July. Abstracts Nos. 1110–1265. Pp. 217–248. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

Norman Lockyer Observatory. Director's Annual Report, April 1, 1932–March 31, 1933. Pp. 8. (Sidmouth.)

East African Agricultural Research Station, Amani. Fifth Annual Report, 1932–33. Pp. 47. (London: H.M. Stationery Office.) 1*s.* net.

Journal of the Chemical Society. August. Pp. iv+917–1111+viii. (London: Chemical Society.)

The Quarterly Journal of the Geological Society of London. Vol. 89, Part 3, August 25th. Pp. lxxxvii–cxxiii+201–356+plates 19–33. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1932. Pp. 17. (Birmingham.)

The Botanical Society and Exchange Club of the British Isles. Vol. 10, Part 1: Report for 1932 (with Balance Sheet for 1932). By William Harrison Pearsall. Pp. 4+4+55 plates. 10*s.* Vol. 10, Part 2: Report for 1932 of the Botanical Exchange Club. By Dr. W. A. Sledge. Pp. 425–457. 4*s.* (Arbroath: T. Buncle and Co.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1933–1934. Pp. 92. (Edinburgh.)

Public Museum, Gloucester. Occasional Papers No. 1: Catalogue of Potters' Stamps on Terra Sigillata found in Gloucester. By Charles Green. Pp. 14+1 plate. (Gloucester.) 6*d.*

Battersea Polytechnic, Battersea Park Road, London, S.W.11. Evening and Afternoon Courses and Classes: Calendar for the Session 1933–1934. Pp. 31. Technical College for Day Students and Day School of Arts and Crafts: Calendar for the Session 1933–1934. Pp. 48. 3*d.* Domestic Science Department and Training College: Calendar for the Session 1933–1934. Pp. 32. 3*d.* Department of Hygiene and Public Health: Calendar for the Session 1933–1934. Pp. 24. 3*d.* (London.)

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 3, Part 4, August. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. iii+231–311. (London: G. Bell and Sons, Ltd.)

Journal of the British Society of Dowsers. No. 1, September. Pp. 20. (Lindfield.) 1*s.*

OTHER COUNTRIES

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 35, Part 1: A Contribution to the Knowledge of Regeneration in Higher Plants. By Kinziro Kakesita. Pp. 100. (Tokyo: Maruzen Co., Ltd.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 96: Thermal Convection of Liquid, laden with some Powder. By Yonekito Hudino. Pp. 419–433+plates 10–18. (Tôkyô: Koseikai Publishing House.) 30 sen.

The Science Reports of the National Tsing Hua University. Series A: Mathematical and Physical Sciences, Vol. 2, No. 2, July. Pp. 75–141. (Peiping.) 1 Mexican dollar.

Proceedings of the United States National Museum. Vol. 82, Art. 23: A New Protozoan from the Larva of the Beetle *Osmoderma scabra*. By Clarke Courson Zeliff. (No. 2964.) Pp. 3+2 plates. (Washington, D.C.: Government Printing Office.)

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1932. By Dr. W. Youngman. Pp. D177. (Colombo: Government Record Office.) 1.80 rupees.

Indian Journal of Physics, Vol. 8, Part 1, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 17, Part 1. Conducted by Sir C. V. Raman and Prof. K. S. Krishnan. Pp. 93. (Calcutta.) 2.8 rupees; 3*s.*

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 27, 1931, No. 3. Pp. 327–477. (Calcutta.) 3.12 rupees.

Bureau of Education, India. Pamphlet No. 30: Question Papers set for the Chiefs' Colleges Diploma and Higher Diploma Examinations, 1932. Pp. iii+67. (Delhi: Manager of Publications.) 1.2 rupees; 2*s.*

Proceedings of the Imperial Academy. Vol. 9, No. 7, July. Pp. xix–xx+285–346. (Tokyo.)

Annual Report of the Director of the Institute for Science of Labour for 1932. Pp. ii+25. (Kurasiki.) 60 sen.

Rubber Research Institute of Malaya. Annual Report, 1932. Pp. ii+148. 1 dollar. Planting Manual No. 5: The History and Description of Clones of *Hevea brasiliensis*. By C. E. T. Mann and C. C. T. Sharp. Pp. 68. 2 dollars. (Kuala Lumpur.)

Tanganyika Territory: Geological Survey. Annual Report, 1932. Pp. ii+40. (Dar es Salaam: Government Printer.) 2*s.* 6*d.*

Trinidad and Tobago. Administration Report of the Conservator of Forests for the Year 1932. Pp. 24. (Trinidad: Government Printing Office.) 10*d.*

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research, Vol. 11, No. 1, July, Research Papers Nos. 573–583. Pp. 162. (Washington, D.C.: Government Printing Office.) 25 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 97: The Lift on a Flat Plate placed near a Plane Wall, with Special Reference to the Effect of the Ground upon the Lift of a Monoplane Aerofoil. By Susumu Tomotika, Takeo Nagamiya and Yositada Takenouti. Pp. 60. (Tôkyô: Koseikai Publishing House.) 40 sen.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 32, Part 5: Studies on the Rot-Disease of Rice-Seedlings caused by Pythium-Species. By Seiya Ito and Yosio Tokunaga. Pp. 201–228+plates 14–18. (Tokyo: Maruzen Co., Ltd.)

Transactions and Proceedings of the New Zealand Institute. Vol. 63, Part 3, June. Pp. iii+237–392+plates 28a–40. (Dunedin.)

Canada: Department of Mines: Mines Branch. Gold in Canada, 1933. By A. H. A. Robinson. (No. 734.) Pp. vii+92. (Ottawa: Acting King's Printer.) 20 cents.

CATALOGUES

Wild-Barfield and Gibbons-Wild-Barfield Box-Type Electric Furnaces with "Heavy-Hairpin" Elements. Pp. 12. (London: G. W. B. Electric Furnaces, Ltd.)

pH Values: What they Are and How to determine Them. Third edition. By T. Tusting Cocking. Pp. 16. Catalogue of B.D.H. Indicators and Accessories for the determination of Hydrogen Ion Concentration. Pp. 16. (London: The British Drug Houses, Ltd.)