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Gold in Kenya and Native Reserves

AS has happened on more than one occasion in the past, proposals gravely affecting the future of the native population of a British dependency have almost reached the point of being given effect before they have attracted public attention. In order that the gold recently discovered in Kenya may be worked, any land in the occupation of natives required for the leasing of mining rights is to be excluded from native reserves and the occupants dispossessed. To make this possible, amendments to the Native Lands Trust Ordinance have been drafted and embodied in a Bill which on December 21 passed its second reading in the Legislative Council of Kenya Colony.

When questioned in the House of Commons on December 20, the Secretary of State for the Colonies stated that the amendments had received his approval as an interim measure to facilitate the granting of leases and to remove any immediate difficulties which might retard the development of valuable minerals, property in which was vested in the Crown. Notwithstanding his assurance that he had satisfied himself that the interests of the natives would be fully safeguarded, it is impossible to receive this announcement without a feeling of unease. No information has as yet been made public to indicate the manner in which these safeguards will be made operative, in view of the conditions affecting native life in Kenya.

The amendments to the Native Lands Trust Ordinance, as they stand in the Bill, and as they have been explained by the Colonial Secretary in the House of Commons, will appear to the native as a breach of trust. They abrogate specific undertakings made on the part of the British Government. On their face they do not meet the needs of the situation which, inevitably, will arise.

What is the nature of these proposals? Briefly, they are that land may temporarily be excluded from a native reserve for the purpose of granting leases for the development of valuable minerals, and that in such cases compensation may be made by money payment, instead of being given in the form of land. The Colonial Secretary added that where compensation was given in the form of a money payment, it would be at least equal to what would have been given to a white settler; and the Chief Native Commissioner of Kenya stated that no native would be "a penny the worse" for the proposals.

In dealing with a white settler this attitude would be just, and the treatment meted out to him would, in all probability, be generous. In dealing with the natives the same treatment is neither just nor expedient. It deliberately sets aside the lessons which have been taught by scientific study of native institutions, of native modes of life and of native ways of thought.

The Native Lands Trust Ordinance is to the natives of Kenya their Magna Charta. It ensures to them their rights in their lands. It sets aside land as a native reserve; and it enacts that when, for the direct benefit of the native, land is taken from the native reserve, compensation shall be made by the addition of alternative land of an equal area. This is no mere concession to sentiment. It is a recognition that land is a vital factor in tribal life. At the same time, in setting aside tracts of land in exclusive native occupation, it provides a measure of protection for native institutions against the disintegrating impact of white civilisation.

The economic, social and religious life of an East African tribe or family group, speaking generally, is bound up with its land. Their only form of wealth is cattle, of which the importance is fundamental in the regulation of marriage and, indirectly, of all the social ramifications which issue therefrom, inheritance, status and the like. The group lives normally on the produce of its gardens and cultivated land. Land is a tribal possession, and its tenure by smaller groups determines relation to the chief, by whom it is allotted as the head of the tribe. Hence land is not only an essential for the subsistence of the tribe by pasture and tillage but also the basis of tribal solidarity. On the other hand, the spiritual relations and associations with the land are even more binding. It is the home of the ancestors, not of the dead, but of living spirits, and upon it grow the sacred trees at which the people from time immemorial have made offering to spirits, and of which the sanctity is such that damage to the least of their twigs may bring untold misfortune on the tribe.

Differences exist, naturally, from group to group; but as generally outlined, these are the factors, material and spiritual, with which any measure for dispossession will have to cope. It is improbable that any considerable number of the dispossessed natives will be settled on other land; and they can be given no security of tenure. This has been made plain. It has been

said that they will not like being settled on land from which they can be ejected. It goes deeper than that. The tribes will have lost their sovereignty, to use the jurist's term. Their tribal status will have gone and they will see themselves, like other East African tribes settled on lands in the possession of others, sinking to serfdom.

On the other hand, those for whom no land is available, to whom a money payment—into a tribal fund—will be made, will receive a form of compensation they do not understand and for which they will have little or no legitimate use. They have no conception of either the employment or the value of money as an economic factor. The example of those who have gained experience of European currency by wage-earning proffers a warning. The money, usually, has been squandered and wasted, while its expenditure, by giving the individual an exaggerated idea of his importance, has loosened the bonds of tribal discipline and respect for chiefs and elders. As for the tribal fund, the experience of America, when the discovery of oil on a reserve has enriched an Indian tribe, has furnished an example of the difficulty of regulating expenditure to the tribal good. The money has been wasted and frittered away.

In introducing the amendments in the legislature on the occasion of the second reading of the Bill, the Chief Native Commissioner said that he feared that the amendments would be "unpopular" among the natives, and admitted that it would be necessary "to hurt their feelings, wound their susceptibilities, and in some cases violate their most cherished and sacred traditions by moving them from their land". Thus it is patent that the Administration has chosen this course of action, not through ignorance of facts, which anthropological science might have made available, but deliberately and with premeditation. It has elected to set aside the consideration of matters which are within the knowledge of, at least, the chief officer to whom the care of the natives has been entrusted and upon whom the responsibility of introducing and explaining the proposals has been laid.

It would seem a not improbable contingency, especially in view of the religious susceptibilities of the tribes, that the proposals, if carried into effect, will cause serious tribal unrest. The extent to which that unrest may spread is impossible to forecast, even if it is confined to the gold-bearing area, for this the authorities are at present unable to delimit. But quite apart from the

possibility of tribal disturbance, the very serious problem arises of the future of the dispossessed natives, deprived as they will be of their only means of livelihood. Divorced from the land, tribal organisation and tribal discipline will disappear. Members of the tribe will become 'landless men', whose only recourse will be labour in the mines—had the Administration this in view as a possibility?—or to drift to the towns and European employment and, thoroughly detribalised, to add to the gravity of the problem, already grave, of the native rabble, saturated with vice, which threatens to become a menace to the European.

Much hangs on the decision to dispossess the native of his land. It is not a question that can be settled by a simple balancing of immediate gains and losses. The native cannot, like a white man, be compensated for disturbance by a money payment, however generous; and even if the exclusion of land were really to be temporary, in the sense that it lasted for a very brief duration of time—a matter that no one can judge at present—when once the native has been divorced from his land, the break-up of tribal institutions and the consequent detriment to morale are irrevocable. Among other tribes who remain undisturbed, confidence in the integrity and singleness of purpose of the Administration in dealing with native affairs will have been badly shaken.

Of those who have followed closely the trend in the development of the African in the years which have followed the War, a majority are convinced that for the safety of the European and the well-being of the African himself, progress must come through the gradual development of native institutions in harmony with native ways of thought; that safety lies in the support, the moulding and the building up of native ways of life and thought and not in violently breaking them down.

When, a few years ago, in Australia a large tract of land was set aside as a native reserve, the two States concerned concurred in forbidding prospecting for minerals on native lands. In Kenya an immediate and easily won prosperity may be dearly bought at the cost of an incalculable addition to the native problem and the weakening of the stock, physically and morally, from which the future population of the country will be drawn. Is it possible to reconcile the action now contemplated with the spirit, much less the letter, of the famous White Paper which enjoined that the interests of the native should be paramount?

Spectroscopic Analysis by X-Rays

Chemical Analysis by X-Rays and Its Applications.

By Prof. Georg von Hevesy. (The George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University.) Pp. xi + 333 + 28 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 3 dollars.

FOR a long time the line spectrum of an element has been used as a means for its identification and, more recently, spectroscopic methods have been developed not only for qualitative but also for quantitative chemical analysis. If the optical spectrum has been found so useful in the practical problems of analysis, it is only to be expected that the X-ray spectrum should prove capable of being similarly employed. When the nature and method of excitation of the optical and the X-ray spectrum are compared, it becomes clear that the latter has much to commend it. In the first place, the X-ray spectrum is much less complex and remains practically unaltered by changes in external conditions. Again, all the elements have similar spectra which differ from one another only in a regular and continuous decrease in the wave-lengths of corresponding lines as the atomic number increases. It is thus possible to predict with accuracy the X-ray spectrum of an element. Further, in order to excite the optical line spectrum, it is necessary to vaporise the material, while the X-ray lines can be obtained without the destruction of the material under investigation.

The important part which X-ray spectroscopy was destined to play in chemical analysis was foreshadowed by one of the deductions which Moseley made from his earliest measurements of X-ray wave-lengths. Even from the incomplete data at his disposal, he could and did deduce the number of elements between hydrogen and uranium which still remained to be discovered. Since then, several of these have been found and X-ray methods have played an important part in their discovery and identification.

Following on the pioneer work of Moseley, the comprehensive and highly accurate work of Siegbahn and his school has given us a very complete knowledge of the X-ray wave-lengths characteristic of the various elements. Apart from the fundamental importance of such measurements in connexion with the problems of atomic physics, they provide all the necessary data for the application of X-ray methods to the problems

of chemical analysis. The importance of X-ray spectra in the solution of such problems is certainly more than sufficient to justify the publication of a book devoted to the subject and it would have been difficult to find anyone better qualified to write such an account than Prof. Hevesy, who has contributed so much to its development.

The earlier chapters are devoted to a discussion of the nature and production of X-ray spectra and contain an admirable account of the various ways in which such spectra may be excited and measured. This section, besides containing the description of all the necessary apparatus and methods, is full of information which will prove invaluable to the actual worker in this subject and is not readily accessible elsewhere. Naturally, for qualitative analysis, the method is exceedingly simple; the mere occurrence of lines corresponding to the characteristic wave-lengths of an element imply the existence of that element and a very rough quantitative analysis is obtained by a comparison of the intensities of the lines of the various elements. For many purposes, however, such an analysis is insufficient and accurate quantitative results are essential. It is in obtaining such results that the unsuspecting worker is liable to fail, unless he is aware of the many pitfalls and how these may be avoided by the use of a proper technique. These difficulties are discussed in detail by Prof. Hevesy and full accounts are given of methods which enable an accurate quantitative analysis to be made even when the element in question occurs only in very small quantities. The actual sensitivity of the method depends upon the nature of the material under investigation. In the analysis of minerals, it is possible to determine a concentration of about one part in 10,000, while in more favourable circumstances such as, for example, the determination of titanium in iron, a much higher sensitivity is obtained.

Of particular interest is Prof. Hevesy's description of analysis as carried out by the use of secondary X-radiation. Instead of mounting the material on the anticathode of the X-ray tube and analysing the radiation emitted by it as a result of electron bombardment, the material is mounted inside the tube in such a way that it is not bombarded by electrons but is subject to an intense X-radiation from a suitable anticathode. This method involves longer exposures but has the very great advantage that it avoids the heating

up of the material and its possible change in constitution as a result of the evaporation of the more volatile constituents.

The remaining sections of the book deal with applications to special problems. As typical of these a full account is given of the discovery of hafnium and of its properties. This section is all the more interesting since it comes directly from one to whom the discovery was largely due. Incidentally, detailed accounts of the chemical properties and the optical spectrum of the element are included. The last section deals with the chemical constitution of the earth and contains a discussion of the relative abundance of the various elements in the earth and in the sun and stars. This may appear to be somewhat outside the natural scope of such a volume, but in actual fact X-rays have proved of considerable value in the determination of the relative abundance of the rarer elements in rocks and meteorites. Of special interest is the use of X-ray analysis to estimate the age of rocks by a determination of the uranium, thorium and lead content.

This is a book alike for the specialist and for the general reader. The specialist will find it full of instructive detail and most useful and comprehensive tables, and indispensable for reference purposes. The general reader will find a very readable account of one of the most interesting developments of the discovery of X-rays and much other information besides. The many excellent illustrations add considerably to its attractiveness.

Medical Biography

- (1) *Osler and other Papers*. By Prof. W. S. Thayer. Pp. vi + 386. (Baltimore, Md.; The Johns Hopkins Press; London: Oxford University Press, 1931.) 21s. 6d.
- (2) *The Genius of Louis Pasteur*. By Piers Compton. Pp. ix + 361 + 8 plates. (London: Alexander Ouseley, Ltd.; New York: The Macmillan Co., n.d.). 12s. 6d.
- (3) *Ronald Ross: Discoverer and Creator*. By R. L. Mégroz. Pp. 282 + 4 plates. (London: George Allen and Unwin, Ltd., 1931.) 10s. 6d. net.

OF these three books, the first, which is written by a medical man, will appeal most to members of his profession, while the other two, which are the work of laymen, are more suited for the general reader.

(1) Dr. W. S. Thayer, formerly professor of medicine in the Johns Hopkins University and a former president of the American Medical Association, collected in a single volume a number of addresses and papers mainly of a biographical nature which he had delivered or published at intervals during his professional or university life. Five of them, which are devoted to the late Sir William Osler in his aspects as teacher, man and booklover, are undoubtedly the most interesting part of the book, in view of the close friendship that existed between Osler and the author for so many years.

The centenary of the publication of Laennec's classical work on auscultation which appeared in 1819 is celebrated by an address which Thayer delivered before the Canadian Medical Association at Quebec on June 26, 1919. After describing Laennec's contributions to medicine, Thayer deplored the present tendency in Canada and the United States to neglect clinical examination as taught by Laennec and Auenbrugger, the inventor of the method of percussion, in favour of laboratory reports.

Pasteur is commemorated by an address on his contributions to medicine and humanity which Thayer delivered at the Sorbonne on May 22, 1927, on the occasion of a meeting organised by the American Committee for the Commemoration of the Centenary of Pasteur's Birth.

Attention should also be directed to the address on the life and work of Richard Bright given at Guy's Hospital on July 8, 1927, on the occasion of the centenary of the publication of the first volume of Bright's medical cases which contains the description of the disease bearing his name.

The other biographical studies are connected with Reginald Heber Fitz of Boston, U.S.A., who in 1886 gave the first full account of the now familiar condition which he named appendicitis; John Howland of Baltimore, an eminent specialist in children's diseases; and Cotton Mather, the seventeenth century Congregationalist minister of Boston, elected F.R.S. in 1713, who among his unpublished manuscripts left a work entitled "The Angel of Bethesda: an Essay upon the Common Maladies of Mankind" as well as a small volume containing rules of health drawn up for the use of candidates for the ministry. Copious extracts from these two curious works are given.

The many friends and admirers of the late Dr. Thayer will be grateful for this collection of his writings, many of which would be otherwise inaccessible.

(2) In his work on Pasteur, whom he describes as "the scientist of the heart", Mr. Piers Compton gives a clear and sympathetic account of the life and achievements of this great Frenchman, relating in succession his studies in crystallography culminating in his discovery of the molecular dissymmetry of tartaric acid; his work on fermentation, and particularly his paper on lactic fermentation, which was the foundation of bacteriology; his overthrow of the doctrine of spontaneous generation; his preservation of the silkworm industry of France by discovery of the nature of the disease and its prevention; his studies in connexion with the French wine and beer industries; his development of the germ theory and particularly its application to surgery; and his work on anthrax and rabies.

Special emphasis is laid on the difficulties with which Pasteur had to contend, including not only illness in himself and his family but also the opposition which he first encountered from the medical faculty particularly in the Paris Academy of Medicine, of which he was elected a member, although he had never obtained a medical qualification or been through the ordinary medical curriculum.

(3) The biography of the late Sir Ronald Ross by Mr. R. L. Mégroz, who has dedicated his book to "all true hero worshippers", is divided into two parts, the first dealing with Ross's life and scientific achievements and the second with his literary work. Mr. Mégroz defends this division first by the claim that he is specially qualified to criticise literary work and secondly by the charge that Ross's literary work has been unduly neglected.

In addition to the account of Ross's life and work particularly in relation to the discovery of the transmission of the malarial organism by the mosquito, the first part contains a chapter in which the writer acknowledges his indebtedness to Mr. Walter Stott, formerly secretary of the Liverpool Mathematical Society, and Mr. J. T. Combridge, of King's College, London, for their exposition of Ross's work in mathematics and its application to epidemiology.

In the second part high praise is bestowed on Ross's work as a satirist, critic, dramatist, lyric, poet and novelist, numerous extracts being given from this comparatively unknown portion of his writings.

Appendices contain a bibliography of Ross's scientific and belletristic writings as well as lists of his honours and awards.

Fish and Fishing

- (1) *The Flyfisher and the Trout's Point of View: New Light on Flyfishing Theory and Practice.* By Col. E. W. Harding. Pp. 208 + 11 plates. (London: Seeley, Service and Co. Ltd., 1931.) 21s. net.
- (2) *Salmon Fishing.* By Eric Taverner. With Contributions by G. M. L. La Branche, Eric Parker, W. J. M. Menzies, J. A. Rennie, A. H. E. Wood, Wyndham Forbes, Thomas Rook and Alban Bacon. (The Lonsdale Library of Sports, Games and Pastimes, Vol. 10.) Pp. vi + 472 + 111 plates. (London: Seeley, Service and Co., Ltd., 1931.) 25s. net.
- (3) *Salmon Hatching and Salmon Migrations: being the Buckland Lectures for 1930.* By W. L. Calderwood. Pp. 95 + 4 plates. (London: Edward Arnold and Co., 1931.) 4s. 6d. net.
- (4) *Silver: the Life Story of an Atlantic Salmon.* By R. L. Haig-Brown. Pp. 96. (London: A. and C. Black, Ltd., 1931.) 3s. 6d. net.
- (5) *The Life of the Sea Trout, especially in Scottish Waters: with Chapters on the Reading and Measuring of Scales.* By G. Herbert Nall. Pp. 335 + 94 plates. (London: Seeley, Service and Co., Ltd., 1930.) 21s. net.

(1) **T**HE rules of fly-fishing are largely empirical and although the dry-fly purist is often no mean entomologist, the immediate aim of an angler is to present a fly to a fish as simply and as unobtrusively as he can; if he succeeds, he seldom worries about the fundamental principles involved, and is content to be frankly anthropomorphic in his outlook to the whole of the piscine world. Seldom, if ever, does an angler consider the point of view of the fish.

Some knowledge of the problems presented by under-water vision we owe to the fascinating work of Dr. Francis Ward. Col. Harding's book develops this theme and is primarily of interest to anglers. Avoiding all technicalities with commendable care, the author shows by a series of simple diagrams how the phenomena of refraction and total reflection influence the rays which reach the eye of the fish and there give an image which is quite unlike that which most anglers would imagine to be the case. The application of these principles is chiefly concerned with problems peculiar to fly-fishing, but they deserve the careful attention of all who are interested in life in surface waters.

Some of Col. Harding's conclusions will probably provoke criticism, for anglers are notoriously sceptical of innovation. From a scientific point of view, the main arguments are convincing although they raise extremely difficult problems. The reactions of a fish to its visual environment will not only depend upon the optical image which falls on the retina of the eye but also upon how far the fish's sensations from such an image are comparable to our own; the reduced and distorted image of an angler on the bank may induce a sensation much more acute than it would in the human brain. If an angler is to be a physicist and a physiologist, must he not also be a psychologist? The prospect may be a little terrifying but Col. Harding's book is an extremely stimulating contribution to literature and will give pleasure to all who are interested in fish or fishing.

(2) Mr. Taverner's book on salmon fishing forms a natural sequel to his previous volume (also in the Lonsdale series), which was devoted to the trout. The present work is worthy of its author and worthy of the series in which it appears. The author is an expert and a scholar, but he also knows how to impart his knowledge to those less skilful than himself. For this reason, Mr. Taverner's book can freely be recommended to all who can afford to have even a remote interest in salmon fishing.

The literature of angling is outrageously large and it is swelled by works which have, at best, a transitory value, but the present work is in quite a different category, for the author has taken the pains to impart his knowledge in such a way that experts and beginners can read his pages with both profit and pleasure. The book covers every aspect of salmon fishing and every stage of the salmon's life from the moment the egg is laid until the adult fish lies, like a bar of silver, at the angler's feet. Mr. Taverner has consulted fellow experts and with real ability he has expressed their wisdom in 450 pages every one of which gives a thrill of interest and has its value. The book is beautifully illustrated by half-tone figures and by numerous useful diagrams.

Both author and publishers are to be heartily congratulated on their work and a perusal of the ordinary edition makes one envious of those who can afford the edition *de luxe*. It is just a little unfortunate that such an admirable book should not have had a rather more attractive page, the margins of which are narrow while the type is none too clear—but such remarks border

on captious criticism. It is a thoroughly good book.

(3) Dr. Calderwood's little book is a small but scholarly production. It gives in a condensed but readable form the conclusions to be drawn from the important work done recently in Canada and other places on the effect of stocking rivers with fry which have been reared artificially in hatcheries. The facts show fairly clearly that the rate of increase in the number of 'migrating' fish derived from a standard number of parent fish can be definitely increased by hatchery methods. In all cases, however, the percentage mortality of fry is extremely high; hence, if hatcheries are to effect any serious increase in the stock of mature fish, they must be established on a very large scale.

Dr. Calderwood also gives an interesting account of what little is known of the migrations of salmon in the sea, and he provides an interesting map. At the end of the book, the author describes a record leap of a salmon at the falls on the River Orrin, in Ross-shire—a leap of eleven feet and four inches.

(4) "Silver" was an Atlantic salmon and the history of his life is told as a bed-time story for children. The author tells us that he has tried to make it interesting and at the same time tried to keep to the truth about salmon and their ways. Those who read this book will readily forgive any digression—if such there be—from strict and academic truth. The story is written in simple yet graceful language and the theme is worked out from beginning to end with real insight and outstanding ability. Those who feel that the teaching of Nature can impress upon a child's mind a healthy outlook on life and on death, will appreciate this book and will read the story of "Silver" and his mate with keen delight.

Mr. Haig-Brown has written a book which will rank highly as a permanent contribution to literature. It is to be hoped that it will receive the wide circulation which it undoubtedly deserves.

(5) Although the sea-trout is perhaps the most attractive of our migratory fish, its life-history is seldom familiar to anglers or to biologists. For many years Mr. Nall has devoted his attention to this fascinating and important problem, and the present book represents a summary of his work and an exposition of his views. It is, as the author says, an attempt to review his own work in perspective. The whole story is admittedly incomplete, but Mr. Nall has performed a real service to biology by putting into book form a series of data

which are not only inaccessible to many ordinary people, but also form a solid foundation for future work.

The opening chapters deal with the technical problems inherent to all such investigations, and the critical analysis to which Mr. Nall subjects his own methods of observation inspires a confidence in his ability to interpret scales in terms of age and life-history. In Chap. vi an interesting contribution is made to the vexed problem of the systematic relationship between the sea-trout and the brown trout. Systematists usually deny any specific differentiation between the two forms, in view of the absence of all significant structural differences. To this view Mr. Nall gives qualified support, but he takes a wider—and a better view—of the essential criterion of a species. He is satisfied that there is a diversity of habit or physiological specificity to each type as striking as are the diversities of structure which satisfy the usual systematic requirements. These diversities of habit ensure that the two forms "keep apart on the spawning beds" and breed true. Behind him, Mr. Nall will find a solid body of opinion from those whose knowledge is based on their observations as anglers. That the two 'species' are closely related is obvious, and there can be little doubt that the migratory form is the more primitive of the two.

Among the perplexing problems offered by the sea-trout are those concerned with the factors responsible for the marked variation in the rate of growth and in the habits of fish taken in different localities. These factors are highly complex and only very extensive and reliable data will enable us to form an adequate estimate of the rôle which is played by each environmental factor. As yet, such data are clearly wanting and consequently the account given by Mr. Nall is of peculiar value. Unless the reader is very familiar with the remoter districts of the British Isles, this section of the book could be improved by the addition of a map. Apart from this slight omission, the book is well illustrated, and the half-tone illustrations are both beautiful and instructive.

Mr. Nall covers every aspect of the fish's life, and raises many interesting problems of scientific and economic importance. How far do sea-trout migrate away from coastal waters? In many cases (for example, Beaully Firth fish), they apparently stay comparatively close to the shore, but, in other cases, journeys of two hundred miles do not appear to be uncommon. Problems of this

type offer full scope for future work—and it is hoped that the publication of this book will help to provide an adequate solution. The author handles his data on growth and maturity in a rather depressingly orthodox manner, but the facts are there for all who care to analyse them differently. The whole book is a mine of information and it is a book for the specialist; at the

same time it should be read by all anglers who know and appreciate the sea-trout.

In his introduction, Mr. Nall explains that he is not and never has been a member of the Fishery Board for Scotland; it is fortunate that at least one of the fishery boards of Great Britain has the ability to attract and to keep the voluntary services of an efficient and enthusiastic colleague.

Short Reviews

Education for Trades and Industries: a Historical Survey. By C. T. Millis. Pp. 164. (London: Edward Arnold and Co., 1932.) 6s. net.

MR. C. T. MILLIS has performed a service in bringing together in this little book much information relating to the early history of the development of technical training for apprentices and craftsmen in various trades and industries. Himself a pioneer in this sphere of work, he has been able to place on record much that might otherwise have been lost. Those technical educationists of a later generation, reading of the struggles of their predecessors to provide for industry a mentally and manually competent personnel, will not fail to realise the debt owing both by themselves and by industry to these earlier workers. Nor will they omit from their list of benefactors many of the individual City Livery Companies and the City and Guilds of London Institute.

Mr. Millis deals in separate chapters with some eighteen of the most important trades; and there is also a short chapter devoted to technical education for women. An account is given in each case of the first classes to be formed and of the development that has taken place up to the present day. Perhaps an undue prominence has been given to the names of those who were primarily concerned with metropolitan training schemes; for the remarkable extension of technical education in the industrial north has not been brought about without its own pioneers. Surely, for example, the name of the late Mr. J. H. Reynolds, one of the greatest and most far-seeing of all the early technical educationists, deserves more than a single passing reference, and that under the heading of photo-engraving and lithography.

The author has drawn largely and rightly upon his own personal experience: this, while adding to the interest of the book, has resulted in a picture with London high-lights and the provinces somewhat in the shade. A completely satisfactory history of education for the trades and industries of Great Britain has, indeed, yet to be written. Meanwhile, Mr. Millis's book should be read by all who are interested in the development of craft training.

The Form and Properties of Crystals: an Introduction to the Study of Minerals and the Use of the Petrological Microscope. By A. B. Dale. Pp. x + 186. (Cambridge: At the University Press, 1932.) 6s. net.

IN this small volume Miss Dale has endeavoured to provide the minimum amount of crystallography and optics necessary for students whose main interests are petrological. It is a difficult task at best, but on the assumption that traditional lines are to be followed, the general scheme may be commended. The author has evidently been at pains to write simply.

The chapter dealing with stereographic projections contains a number of straightforward examples worked through in detail, which should help in mastering what is to many a forbidding subject. Unfortunately, however, the book is somewhat marred by a number of mistakes. The treatment of refractive indices is not very satisfactory, and the reference in the text to the chart of birefringences inverts ordinates and abscissæ. Fig. 117 and its context provide a puzzle; the reviewer looked long and carefully at these without understanding anything at all. The customary phrase 'convergent polarised light' is not a happy one at the best of times, and although students will probably manage to obtain an interference figure by following the appropriate directions, they will be well advised to be wary of interpreting what they see in the light of this illustration.

F. I. G. R.

Methods in Plant Histology. By Prof. Charles J. Chamberlain. Fifth revised edition. Pp. xiv + 416. (Chicago: University of Chicago Press; London: Cambridge University Press, 1932.) 18s. net.

THIS, the latest edition of Prof. Chamberlain's book, needs little introduction to workers in a botanical laboratory. The changes are many and important, amounting almost to a re-writing. The new chapter on "Illustrations for Publication" will prove helpful to many research workers and the mention of a section on "Movie Photomicrographs" will serve to indicate how the different editions march with the times. Directions for collecting, fixing, dehydrating and staining material

have been improved and amplified and refinements of technique are detailed, which make it easy to obtain sections as thin as 2 or 3 microns, while thinner sections down to a thickness of 0.5 micron can be made. Prof. Chamberlain's hint as to the possible appearance of a microscope of such magnifying power that no section thicker than 1μ is permissible, is rather intriguing and will demand further improvements in histological technique along these lines. The amplifications noted have involved no curtailment of the sections dealing with the collecting and growing of all types of laboratory material and with the application of the principles of fixing and staining in the study of each group of plants—these sections constitute the second part of the book as in the earlier editions. N. F.

Caratteristiche dei sistemi differenziali e propagazione ondosa. Per Tullio Levi-Civita. Lezioni raccolte dal Dott. G. Lampariello. (Attualità Scientifiche, N. 41.) Pp. vii+110. (Bologna: Nicola Zanichelli, 1931.) 15 lire.

THIS little book is founded on a course of lectures, given by the author at Rome in 1930-31, on the theory of characteristics of partial differential equations and their applications (following the methods originated by L'Hugoniot and developed by Hadamard) to wave motion in acoustics, elasticity, optics, electromagnetism and other branches of physics. It opens by recalling some existence theorems concerning partial differential equations. The characteristics are introduced as the loci of singular points where these theorems break down. We then pass on to the consideration of wave motion, and wave surfaces prove to be closely connected with characteristics. The most interesting part of the book is the concluding section, which deals with the wave-particle dualism of modern physics according to de Broglie. An account is given of the recent dynamical-optical work of Persico, which aims at making Schrödinger's wave equation plausible, and a tantalisingly brief reference is added concerning Racah's use (in 1931) of the principles expounded in this book to obtain a justification of Heisenberg's principle of indeterminacy. Most readers will probably wish for a fuller account of the new developments so briefly mentioned here.

H. T. H. P.

The Grey Squirrel: the Introduction and Spread of the American Grey Squirrel in the British Isles, its Habits, Food and Relations with the Native Fauna of the Country. By A. D. Middleton. Pp. viii + 107 + 8 plates. (London: Sidgwick and Jackson, Ltd., 1931.) 4s. 6d. net.

THE grey squirrel has become almost as valuable as the sea-serpent to correspondents of British newspapers, and genuine inquirers who are distraught between the assertions of the 'pro-squirrelites' and the 'anti-squirrelites' will be glad to have this authoritative work at hand. It touches upon the life of the grey squirrel in its

native home in eastern and central North America, but its real purpose is to describe the invader in the land it has invaded with such success that from one centre (out of about thirty) it has spread over 1,350 square miles, and that, in thirty years. The food and habits, the much discussed relations with the native red squirrel and other animals, and the economic aspects of the pest are dealt with thoroughly, the conclusion being reached that three main counts have been proved against it—damage to forests by peeling bark and destroying shoots, destruction of agricultural and garden produce, including fruit, and destruction of birds' eggs and young. Suggestions are made for the destruction of grey squirrels, but the seriousness of the menace in the British Isles has not yet been realised.

The Background of International Relations: Our World Horizons, National and International. By Prof. C. Hodges. Pp. xvi + 743. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 21s. net.

AN excellent compendium of world politics viewed from a common-sense angle, this book illustrates the point that international politics should be everybody's business. The basic principles of politics are the refined result of the crowding of the globe and the struggle for elbow-room and racial survival. So business has become the driving force in politics; and economic hunger drives nations to seek commercial supremacy backed by the power of the State. Yet enlightened self-interest forces these nations into world co-operation through political or non-political means. Yesterday's isolation of nations has gone: statesmanship has now to deal with news-minded nations. The author believes that knowledge alone can control the destiny of peoples, and that world-forces do not yield to emotions. There is much to be said for his final statement that peace is a state of mind, and not a political institution. A wealth of references and a good index are features which add to the practical value of this work. T. G.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: with a Record of Publications issued during Session 1931-1932. Compiled from Official Sources. Forty-ninth Annual Issue. Pp. vii+167. (London: Charles Griffin and Co., Ltd., 1932.) 10s. net.

THIS annual, which has now reached its forty-ninth year, supplies valuable information concerning learned societies of Great Britain and Ireland, including officers, conditions of membership, meetings, publications, etc., and also gives particulars of various government scientific institutions. The new form of the publication initiated last year, which involved omitting lists of papers read before societies, has been continued this year. Many societies have been added, thus adding to the value of the volume as a work of reference.

Volcanic Craters in the Libyan Desert

By Dr. K. S. SANDFORD

IN the last few weeks, reports of the occurrence of volcanic craters in the Libyan desert have appeared in the daily Press. It seems wise, therefore, to define the discoveries more precisely as soon as possible, although detailed study of the material collected must be postponed for several weeks.

In the spring of 1932, the late Sir Robert Clayton East Clayton and Squadron-Leader Penderel, R.A.F., observed and photographed some crater-like hills between the Gifl Kebir and Gebel 'Uweinat, near the southern end of the Egyptian-Cyrenaican frontier. Sir Robert also flew over them with Mr. P. A. Clayton, of the Desert Survey of Egypt, who, with Count De Almàsy, was a member of the expedition. Some of their photographs appeared afterwards in the *Illus-*

must be added minor elevations and a thick horizontal sheet of 'lava' which caps a prominent hill nearby; this may have been a surface flow or a sill.

One of the best preserved of the explosion craters was about half a mile wide from east to west and about a quarter of a mile wide from north to south (inside measurements), with vertical walls of hardened Nubian sandstone rising 100-130 ft. above the plain. The centre, partly filled with sand and rubble, was at about the same level as the plain, and water flowing from it has cut a deep channel through the southern wall. Some of the craters evidently now contain lakes after the rare rains, and the remains of mountain sheep and other animals that came to them were common.

Within the main ramparts of at least two of the explosion craters were found subsidiary plugs of white trachytic rock, and adjacent to them the fusion of the sandstone walls was very marked. The relative ages of explosion and flow of molten rock in these multiple craters seemed to vary. Into the white rock had been intruded a dark basalt-like rock of much the same specific gravity as the trachyte: although both rocks varied appreciably in texture over the area, their mutual relation seemed to remain the same.

A noticeable feature of the whole neighbourhood was the presence of double walls of hardened sandstone, running on straight or curved courses over the surrounding plain and across some of the craters. These, and pipe-like tubes of iron sinter penetrating the unbroken Nubian sandstone of the plain, seem to have been formed by hot solutions at a late stage of the period of activity. In some, amorphous and gypseous substances occupied the space (usually four to six feet) between the parallel faces of the double walls.

During our reconnaissance from the craters to Gebel 'Uweinat, we found a similar but smaller area at the north-eastern corner of the massif. Here, in particular, prismatic sandstone, well-known to Messrs. H. J. L. Beadnell and P. A. Clayton from their surveys in adjacent areas, was intimately associated with the type of 'wall' already described.

At about this time, Squadron-Leader Penderel, who had followed our party out from the Nile valley by air, landed beside us and was kind enough to take specimens for me to Cairo, where they were given to Mr. O. H. Little, director of the Geological Survey of Egypt. I am indebted to Mr. Little for some notes which reached me on our arrival in Fasher several weeks later.

A considerable 'volcanic field' may, therefore, now be added to the map between the north-eastern corner of 'Uweinat and about lat. 22° 18' N., long. 25° 30' E. A similar volcanic area, with trachytic rocks, was encountered on the south-western side of 'Uweinat during the investigation of the country

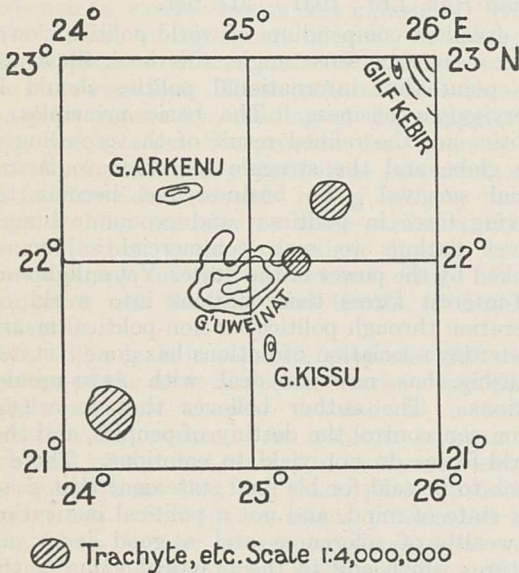


FIG. 1.

trated *London News*, and Mr. Clayton has sent a paper on the western side of the Gifl Kebir to the *Geographical Journal*. The party was unable to visit the craters but their approximate position was computed.

In the first week of October 1932, Capt. Craig, R.E., W. B. K. Shaw, G. L. Prendergast and I set out in a car from Gebel Kissu, the advanced base of the recent expedition led by Major R. A. Bagnold, and found the craters on the same day. Those previously seen from the air proved to be explosion craters; others, less obvious, were found to be the denuded stumps of volcanoes: both types were encircled by high ramparts of steeply tilted, hardened, and locally fused Nubian sandstone. Seven principal hills, standing 100-300 ft. above the plain, are grouped within a radius of about five miles, and to these

westward to Sarra and the Tibesti foothills. It is centred about lat. $21^{\circ} 16' N.$, long. $24^{\circ} 14' E.$, with a radius of about six miles, and most of its denuded stumps were visited by Lieut. D. R. Paterson and myself. There seem to be no explosion craters in this group.

Each 'field' is associated with very slight folds of the Nubian sandstone, and the complex of ancient rocks upon which it lies is exposed in the immediate vicinity by the denudation of the slight surviving thickness of sandstone. The period of volcanicity is obviously far younger than the Nubian series, and the fresh appearance of the explosion craters suggests a fairly recent date of formation.

The discovery of a few stone implements of Middle Palaeolithic type in and near some of the craters necessitates a readjustment of ideas, which is confirmed by comparison with the great crater of Malha, in the Meidob Hills about 150 miles north-north-east of Fasher. Malha seems to

have exploded but yesterday: the basaltic lavas which surround it and have flowed into one corner of it are fresher than many on the flanks of Vesuvius, yet the traditions among the people who depend on the springs within it seem to recall only variations of level of the lake in its centre. These explosion craters seem to be far older than they at first appear.

The presence of light trachytic rocks within a radius of about 50 miles from Gebel 'Uweinat is of interest in contrast to the wide distribution of basalt and dolerite over Egypt and the Sudan, ranging from an Oligocene age in Egypt to at least a semi-recent age at Malha. About 'Uweinat the dolerites seem to be of far greater age than the features described above, but there was a later effusion of basaltic magma at Malha—the presence of basaltic lava and of 'volcanoes' in the Bayuda desert between Berber and Merowe (Dongola) will be recalled—probably long after the trachytes of 'Uweinat were cold.

The Old Morphology and the New*

By DR. H. HAMSHAW THOMAS

"THE full problem of morphology is . . . to explain how in the past plants came to be such as we now see them" (Bower). The problem is often regarded as insoluble, but a survey of the development of morphological concepts suggests that some of our difficulties may be due to the tacit acceptance of theories handed down by successive generations of teachers. In dealing with the flowering plants, almost all recent writers accept the classical concepts originated by Goethe and Lindley in pre-evolutionary days. During the last thirty years, however, a large body of facts has been accumulated about the simpler and older plants, and a new system of ideas has been founded, which is in harmony with our knowledge of the form of the earliest known Devonian land plants. We have now to face the question of the relation between the fundamental concepts of the old morphology and those of the new.

At the outset of any discussion of form, it is necessary to keep in mind the principles underlying our comparisons. In the past, before the coming of evolution, comparisons of plants were mainly subjective, but to-day we aim at an objective approach. Plants are objectively comparable because we consider them to be derived from common ancestors; if we reject the subjective approach, we must introduce phylogenetic considerations.

We owe the term 'morphology' and the foundation of the classical concepts to the poet philosopher, Goethe, who published in 1790 a treatise "On the Metamorphosis of Plants", which has been called "the foundation of all that has since been done in vegetable morphology". The most important conclusion in this essay is that "whether a

plant produces leaf-buds, flowers, or fruits it is still the same organ which is carrying Nature's laws into effect, though performing different offices and disguised under different forms". This one organ is called the leaf, but Goethe appeared to feel that it should be given some more generalised designation.

The spread of this doctrine in England was largely due to Lindley, who repeated Goethe's views and arguments, but he made an important modification in the theory which has received insufficient attention. Goethe wisely wrote near the close of his essay, "The thing now to be aimed at is to keep habitually in view the two contrary directions in which variations are developed. For we may say with equal truth that a stamen is a diminished petal or that a petal is an expanded stamen."

Lindley, however, concludes that "the leaf, as the first formed, the most perfect of all [the appendages] and that which is most constantly present, is properly considered the type from which all the others are derivations". This unsupported assumption was widely accepted, and Darwin in "The Origin of Species" spoke of the view that the parts of the flower consist of metamorphosed leaves as familiar to almost everyone. As the result of Darwin's work, the old concepts of the subjective and idealistic philosophers have been taken over and given an objective significance by biologists.

The doctrine of metamorphosis led to the idea that the parts of plants could be divided into three distinct categories, stems, roots and leaves. This has met with less universal approval. It may be tenable when we are dealing only with the mostly highly evolved forms, but when an attempt is made to extend it downwards grave difficulties are encountered. It has resulted in an unnatural

* From a paper read to the Linnean Society of London on November 10, 1932.

separation of the Thallophyta and Bryophyta from the higher forms.

The major concepts of the classical views have in the course of time come to be considered as so axiomatic that few writers have troubled about the evidence on which they were based, or have followed up their implications. But modern work has cast doubt on most of the arguments used in founding the system. Grégoire has found that the primordia of the stamens and carpels at their first appearance can be distinguished from those of foliage leaves, and so is led to the view that the stamens and carpels are organs *sui generis*. The validity of arguments based on abnormal flowers was challenged some years ago by the late Prof. K. von Goebel, and more recently by Mrs. Arber on the principle of irreversibility in evolution. Thus the only uncontested evidence is that derived from comparisons during the progressive growth of the plant, which, as Goethe pointed out, may be read in two opposite ways.

It might be reasonably expected that the great outburst of morphological research which followed the rise of the doctrine of evolution would provide evidence in support of the fundamental concepts. But no fresh evidence has been obtained. The continental morphologists of the classical school reject all evidence derived from the study of comparative anatomy and vascular structure as worthless, and they likewise seem to reject considerations of ontogeny, cytology and evidence derived from fossil plants. It may be that anatomical and developmental studies are held to have no bearing on morphology because they are known to conflict with the classical concepts. Most English morphologists regard anatomical and palaeobotanical work as valuable, but in attempting to apply new knowledge to old concepts find that more problems are raised than solved.

The general ideas of the new morphology which may be said to have originated twenty-four years ago with the work of Lignier, Tansley and Bower, are based on considerations of phylogeny. The forms of plants and plant organs can only be explained by reference to their origin, and even though we cannot trace back the development of a group of organisms, we may in various ways obtain glimpses of the types of change which have gone on in the past. Fragments of the evolutionary history of one group may enable us to guess what has probably gone on in another group. The classes pteridophytes, gymnosperms and angiosperms may well represent stages in evolution rather than independent groups of organisms, and there is much evidence pointing to parallel evolution in the various groups. When endeavouring to draw the broad generalisations on which a system of morphology is based, it is unnecessary to trace the complete phylogenetic history of all the groups of plants, unless we consider that the different groups have been derived from independent algal ancestors, and that all traces of the previous history of many of them have been obliterated.

Even the present incomplete state of our knowledge enables us to determine the general trend of evolution throughout the ages with some degree of probability, and it may well be that the geological record of plant life is more complete than has previously been supposed. Any general system of morphological ideas should be applicable to all plants, but only one group has yet been fully studied from the new point of view. Prof. Bower's work on the ferns provides us with evidence as to the probable evolution of this group drawn from a number of different aspects. Zimmermann, in a publication of a different character, has shown how well the new views can be applied to the gymnosperms.

From a study of the Pteridophyta and the earlier fossil plants we are led to suppose that the very early land-plants were simple structures of the *Rhynia* or *Psilophyton* type, in which there is little differentiation beyond that of the sporangia. Afterwards roots became specialised from underground branches, and in some groups small simple leaves appeared. The large leaves characteristic of most of the higher plants seem to have evolved from branch systems and long retained traces of this origin. The primitive terminal sporangia either retained their original position or became involved in frond formation and attained a marginal or superficial position; they often formed tassel-like groups and frequently became more or less fused.

These generalisations are quite inconsistent with the classical ideas of morphological development, and call for a modification of our ideas of homologous structures. They suggest that the foliage leaves and reproductive organs of the flowering plants can only be regarded as homologous structures because they are both derived from branch systems. Stamens and carpels have never been typical leafy structures with an expanded lamina, and it is probably misleading to call them sporophylls.

These newer concepts help us to understand the gymnospermous reproductive organs. It is no longer necessary to assume that terminal ovules in *Ginkgo* and *Ephedra* were originally produced on lateral leafy organs which have disappeared without leaving the slightest trace of their former presence. There is a great gap between the Psilophytales and the flowering plants, but it is to some extent bridged by the upper Palaeozoic pteridosperms. The derivation of the *Caltha* type of carpel from a *Caytonia*-like structure has already been suggested, and we can now link the Caytoniales more closely to the pteridosperms owing to the discovery in the Triassic rocks of South Africa of a new group of seed-bearing structures.

When we come to examine all the known pollen-bearing structures of the seed plants with large leaves, it seems as though we can distinguish a gradual progression along two or three distinct lines, commencing with terminal groups of separate sporangia produced in groups, and leading to Mesozoic structures which may either be like branched stamens, structures bearing bean-shaped

synangia, groups of sporangia borne on the surface of a leaf-like structure, or organs resembling the male flowers of the poplar. Nothing is known of a fertile leaf like that envisaged in the classical morphology. The study of these forms, however, suggests that angiospermous flowers may have originated in more than one way.

When we examine the forms of expanded leaves throughout the past, it is impossible to avoid the conclusion that 'compound' leaves are of a more primitive type than 'simple' leaves. In certain cases, however (for example, the Date palm), a new type of compound leaf has probably arisen from a simple form.

In other branches of science the interpretation

of observed facts is facilitated by making successive assumptions and by comparing the theoretical results of each with the observations already made. This procedure has not been followed in plant morphology. The old system provided one set of assumptions only, founded more than a century ago on a very imperfect knowledge of the plant world, and for many years endeavours have been made to harmonise our ever-increasing observations with these postulates, distorting or discarding all those facts which seemed inconsistent. While it is quite probable that the assumptions of the new morphology may prove to need drastic emendation, they may nevertheless serve a useful purpose in the study of plant evolution.

Obituary

MR. H. A. ROBERTS

MR. H. A. ROBERTS, secretary for thirty years of the Appointments Board of the University of Cambridge, died at Cambridge on December 18 at the age of sixty-eight years. After ten years as senior mathematical master at Bath College he returned to Cambridge as a coach in mathematics in 1898. But his life's real work began when he was appointed in 1902 to be secretary of the University Appointments Board. He was keen to develop a new line of openings for university graduates in business and administrative posts, in addition to the more obviously natural academic, professional and technical positions which most men then sought after graduation. By great care in the selection of the men whom he recommended to the firms which applied to the Board, he not only succeeded in overcoming a prejudice against university men in business but he also created a new demand for such men on the part of large industrial undertakings.

Thirty years of devoted service on Mr. Roberts's part brought their own reward in intimate and friendly relations with the heads of industry, with their younger successors who had gone into business under his auspices, and with generations of college tutors, with whom he always worked in the closest touch. Gonville and Caius College elected Mr. Roberts as a Fellow in 1927, his advice was sought in Government circles and in the formation of appointments boards at other universities and for the women's colleges at Cambridge. He retired on account of ill-health only last autumn. It is sad that he should have lived so short a time to enjoy his hard-won leisure, but it is something that he was able to attend, less than a fortnight before his death, a complimentary dinner at which a presentation was made to him on his retirement by a number of those whom he had served so well.

MR. A. R. WRIGHT

MR. A. R. WRIGHT, who died on December 24 at the age of seventy years, played an

important part in organising the work of the examining staff of the Patent Office to its present high level of efficiency and was also a recognised authority on folk-lore.

Wright entered the Patent Office in 1885 and from that date until his retirement forty-two years later worked unremittingly to place the classification of patent specifications for search purposes on a sure foundation. He was the editor of the well-known official series of illustrated class abridgment volumes which were published at the rate of more than fifty volumes a year to cover, by the year 1905, all patent specifications issued up to that time from 1855. The classification scheme on which this mass of material was indexed and through which alone the official search for novelty introduced by the Patents Act of 1902 was made possible, was largely Wright's work, and its amplification in subsequent years to meet the ever-growing amount of search material in the examiners' files and the development of industries and industrial processes was carried out under his personal supervision with a thoroughness and care for detail which were characteristic of the man.

The Patent Office classification as it stands to-day, exceptional in many respects, deserves a high place among the several developed classifications of applied science, and is a worthy memorial to Wright's energy and capacity. He was appointed assistant-comptroller of the Patent Office in 1922, while still retaining the classification as his main charge, and retired from the service in 1927.

As a folklorist, Wright was known not so much for his literary output, which was not large, as for his encyclopædic knowledge of folk beliefs and customs, obtained by extensive reading and an unusually retentive memory, which was ever at the disposal of anyone seeking information, and for the valuable services he rendered through the Folk-Lore Society, of which he became a member in 1890. He was a prominent and active member of the Council of the Society from 1898 until his death, and president for the two years 1927 and 1928, while he was an invaluable editor of the Society's journal *Folk-Lore* from 1912 until 1931.

At the time of his death, Wright was engaged in editing for the Folk-Lore Society the English material which had been gathered together, mainly by his own labours, for a collection of British calendar customs which the Society had decided to publish. All folklorists will regret that his invaluable help and advice have been withdrawn at a time when they were most needed, but this should only be an added spur to see that the task to which he had given so much time and work is completed. Wright was a fellow of the Society of Antiquaries and of the Royal Anthropological Institute, and had many outside interests ranging from the collection of Utopias to the Shakespearian productions of the Old Vic Theatre, which he attended with unfailing regularity until his last illness.

MR. G. STEPHENSON

MR. GEORGE STEPHENSON, who died in Letchworth on December 29, in his seventieth year, was for many years the principal of the Albert Agricultural College, Glasnevin, and lecturer on agricultural chemistry in the Royal College of Science, Dublin. He was born in Yorkshire in 1863, and was educated for the teaching profession, but soon turned to the study of chemistry and physics in their applications to agriculture. He gained a national scholarship and went to the old Royal College of Science at South Kensington, where he studied under Sir Arthur Rücker, Sir Edward Thorpe and Sir Norman Lockyer. He was a student during the years 1887-1889, and was deeply impressed by the lectures and practical classes, and he retained his notes during his whole life. With Sir Norman Lockyer he carried out some spectrographic research, and he would show with pride the photographs he made at that time.

After leaving South Kensington Mr. Stephenson

became science master at Cheadle Hulme School, and later joined the staff of the Agricultural Department of the University of Leeds, but shortly afterwards he accepted an invitation to join that of the Royal College of Science, Dublin, which had been reorganised by the Technical Department presided over by the late Sir Horace Plunkett.

A few years later whilst retaining his lectureship Mr. Stephenson was appointed principal of the Albert Agricultural College, which had been opened in the middle of the last century by the Prince Consort. Here he found the congenial work of teaching and training students, many of whom in every part of Ireland, in Great Britain and throughout the Empire have done most important and useful work for agriculture.

Mr. Stephenson, though a strict disciplinarian where order and method were concerned, was above all things a sympathetic teacher and was never so happy as when helping students, individually, when necessary, with their difficulties. Being a man of wide reading and culture his lectures often extended far beyond the usual curriculum. His students will remember him with love and gratitude, and will regret the passing of so kind and great a teacher. He leaves a number of devoted friends, who will regard his memory as one of their cherished possessions. S. S.

WE regret to announce the following deaths:

Sir John Ballinger, C.B.E., formerly librarian of the National Library of Wales, who did much work in connexion with the organisation of school and village libraries, on January 8, aged seventy-two years.

Mr. G. S. Kemp, who was the Marchese Marconi's first assistant in his first demonstrations of wireless telegraphy, on January 2, aged seventy-five years.

News and Views

British Association: New President Installed

ON January 6, the usual meetings of organising sectional committees of the British Association were held to decide the lines of the programme of the Leicester meeting next September. As under a new statute the annual office of president of the Association corresponds with the calendar year, occasion was taken to welcome Sir Frederick Gowland Hopkins to the chair. Sir Alfred Ewing, the retiring president, in introducing the new president, said that the Association has been fortunate in securing Sir Frederick Hopkins's services. Last year it had been, so to speak, the turn of that part of science which dealt with the constitution of non-living matter, and with purely mechanical processes, which can certainly kill, but cannot make alive. Now the Association turns, perhaps with relief and greater hope, to the still more difficult science of life—of the fascinating problems of which no one can speak with

more authority and clearer discernment than Sir Frederick Hopkins. Sir Alfred stated that it seems not unlikely, and probably it is desirable, that in future meetings of the Association, scientific workers will make a more conscious effort to relate their studies to social problems. Science is now playing so large a part in human life, both for good and for evil, that scientific workers cannot logically stand aloof. Science has brought new powers and new dangers—grave dangers of which the community is scarcely yet aware. It is clearly the duty of science to point these out. After his installation, Sir Frederick Hopkins said that Sir Alfred can be well pleased with his tenure of office and with the delivery at York of an address which in many minds stimulated thought along desirable lines on the readjustment of science and civilisation. Sir Alfred is retiring from office in the full assurance that he has helped the Association greatly.

Miners' 'Claims' and Native Lands in Kenya

ELSEWHERE in this issue (p. 37), we have discussed the grave situation which may arise through the proposed legislation dealing with gold prospecting in native reserves in Kenya. The explanatory memorandum issued by the Chief Native Commissioner of Kenya Colony to the natives likely to be affected has now been published in the *Times* (Jan. 5). It would appear to be fundamentally opposed to the whole conception and purpose of the institution of a native reserve, and is likely to be thoroughly disturbing to the minds of natives nervous for their rights. It seems that no attempt will be made to segregate the native or to control the siting of mining claims. European interpenetration of native holdings on the reserve will be complete. The natives are informed that they may expect to see their holdings 'pegged', or such part of them as may be required, wherever it is thought worth while to look for gold, and their huts and shambas may be destroyed; while they are invited to squat on their neighbours' land and make money, pending the vacation of their own land at some indefinite date, by working in the mines. It is also suggested that natives may sell to the miner meat, chickens' eggs and vegetables, but this applies, presumably, to those who have not been dispossessed of their land. Sir Edward Grigg has rebuked the Archbishop of Canterbury for suggesting that "African interests . . . are likely to receive better and wiser consideration from 'public opinion' in this country than from the Government of the Colony"; but the anthropologist asks "*Quis custodiet ipsos custodes*"? This unfortunate memorandum, issued, be it marked, by the department responsible for the well-being of the native, passes over all that has been achieved by scientific study of native races and of the problems that arise from their unchecked contact with Europeans.

Liverpool School of Tropical Medicine

DR. J. MIDDLEMASS HUNT, who held the post of honorary dean of the Liverpool School of Tropical Medicine for many years, has, by the terms of his will, emphasised the great interest that he took in research on tropical diseases. He has made a bequest of £20,000 to the University of Liverpool in order to provide for the endowment of the chair of tropical diseases of Africa. This will greatly strengthen the position of the laboratory of the School in West Africa originally established under the will of the late Sir Alfred Jones. In the Sir Alfred Lewis Jones's bequest, a sum was set aside for the specific purpose of building a research laboratory in Sierra Leone, West Africa, but no endowment was available. The building was erected as soon as possible after the War, the first director of the laboratory and first holder of the chair of tropical diseases of Africa being Prof. D. B. Blacklock, who remained in charge from 1921 until 1929. The present director and holder of the chair is Prof. R. M. Gordon. The laboratory has a normal staff of three which, in exceptional times, has been increased to five, and combines research on West African diseases with pathological investiga-

tions of a routine nature connected with these diseases. Dr. Middlemass Hunt was impressed by the fact that this overseas development of the Liverpool School of Tropical Medicine lacks any endowment and his generous bequest is evidence of his desire to initiate the consolidation and extension of the work of this important branch of the School.

Institute of British Geographers

THE work, extending over the past two years, of various preliminary committees was brought to a conclusion on January 3 when the Institute of British Geographers held its first meeting and elected a council and officers. The initial membership is open to all present members of the staffs of university departments of geography in Britain; in the future, membership will be by election. With one possible exception, all universities, as well as a large number of colleges of university rank, in Great Britain have now departments of geography and there is thus an obvious need for co-ordinating the teaching and research work of their staffs and for permitting an exchange of views on matters of particular interest in the furtherance of the subject in the universities. The Institute is thus in no way a rival to existing bodies. In discussing problems of special interest to themselves, it is clearly not the desire of university geographers to lose the contact which they have with administrators, travellers and surveyors, amongst others, who provide so much of their material, through the Royal Geographical Society; or with the teachers who have charge of the school training of the rising generation, through the Geographical Association. At the first meeting, papers were read, on "Soils", by Mr. A. Stevens (Glasgow), on the geography of the Arab Empire in Europe, by Mr. W. G. East (London), and on a comparison between the iron industries of Northamptonshire and Lorraine, by Mr. S. H. Beaver (London). The council and officers elected are: *President*: Prof. C. B. Fawcett (University College, London); *Hon. Secretary and Treasurer*: Mr. A. A. Miller (Reading); *Hon. Assistant Secretary*: Dr. H. A. Matthews (Birkbeck College, London); *Council*: Mr. J. N. L. Baker (Oxford); Dr. R. O. Buchanan (University College, London); Prof. H. J. Fleure (Manchester); Prof. Ll. Rodwell Jones (London School of Economics); Prof. P. M. Roxby (Liverpool) and Dr. S. W. Wooldridge (King's College, London).

Centenary of Friedrich Koenig, 1774-1833

FEW things have assisted the spread of knowledge more than the invention of printing from moveable types, the mass production of paper and the introduction of the power-driven printing machine, the last of which we owe to the German printer Friedrich Koenig, whose centenary occurs on January 17. He was born at Eisleben on April 17, 1774, and, after attending school, was apprenticed to a printer of Leipzig and then worked as a journeyman. His first improvements were made in connexion with the ordinary hand press. To further his projects he came to England in 1806, and it was soon after this that

he met his countryman, Andreas Friedrich Bauer (1783-1860), who possessed the mechanical skill Koenig lacked. Four patents were taken out between 1810 and 1814 and from these came the power-driven flat bed printing machine in which the paper was pressed against the type by a cylindrical roller. Through John Walter (1776-1847), two of Koenig's machines were installed for printing the *Times*, and with the appearance of the issue of November 28, 1814, a new era in newspaper production began. Koenig's success, however, was but the prelude to a long struggle against difficulties. Returning to Germany with Bauer in 1817, he founded a works for the building of printing machines at Oberzell near Würzburg, only to find it next to impossible to obtain properly skilled artisans. Five years indeed passed before the partners completed their first German printing machine, and throughout his life Koenig met with little but adversity. He died at Oberzell at the age of fifty-eight years. The business was carried on by Bauer and relations, and afterwards gained a wide reputation. The speed of an early Koenig machine was about two thousand sheets an hour. Improvements by Cowper and Applegarth raised the speed to 5,000-10,000 sheets an hour, the Hoes of America then built machines doubling the capacity and to-day the rate of printing is some fifty times as fast as that in 1814.

Royal Academy Winter Exhibition

OF the Winter Exhibition of the Royal Academy, illustrating the works of members who have recently died, one of the oldest academicians remarked that in no country could be brought together such a fine collection of sound painting from the work of men recently with us. Apart from merit, there is also the pleasure of seeing again pictures notable in their day, some of enduring appeal, while others markedly exhibit the fashion of another age. Both as regards number and interest, Orpen's pictures should be mentioned first. From the student-study, the "Hamlet Play Scene", with its dull browns and reds, the transition can be traced to the clear coldness of the colours in his recent portraits, well on the way to be 'old masters'. One of the most striking, that of the late Sir William McCormick (No. 87), will delight many readers of NATURE. Mid-Victorian days are recalled by the work of the late president, when the fashion was for stained glass windows, flowing garments and red-gold hair. Time was when in every annual exhibition one or more of Harry Tuke's pictures of bathing boys appeared. Here we have a collection of them and find them still pleasing, while Wyllie's sea-pictures are full of life and colour. In contrast with these the Lambert pictures seem wanting in atmosphere, but that of the Red Girl (No. 251) and Round Mirror (No. 260) should be noticed.

PERHAPS too low in tone for modern taste are the pictures of La Thangue, in which French influence is prominent. Great variety is shown in the works of Greiffenhagen, some of it almost heraldic, but including several character studies (Nos. 304, 306

and 325). Of contrast between an earlier and a later style there is none more violent than is exhibited in the work of Sims, from a delicate and poetic touch portraying in delicate mother-of-pearl tints the "Light that never was on Sea or Land", to strange conceptions in harsh reds, yellows and blacks. Many examples of the well-known work of Ricketts as a book-designer will be found in a case in Room IX, while his paintings are hung in the same room against a rose background. Great restraint is shown in the water-colours of David Muirhead, but more freedom is exhibited in his oil-paintings (543, 547).

Education for Industrial Management

OVER the signatures of Lord Rutherford, Sir William Bragg, Sir Josiah Stamp, Lord Eustace Percy, Lord Amulree, Sir Herbert Austin, Prof. C. E. Inglis, Sir Francis Goodenough and others, an important manifesto on "The Management Factor in Industry" was issued on December 31. The manifesto was drafted by a small committee all the members of which are voluntary workers in one or more societies or institutions dealing with functional phases of management. Of this committee, Mr. E. S. Byng was chairman and Mr. S. Townsend, honorary secretary. The manifesto emphasises the urgent need for a full appreciation of the national importance of the management function and of the rapid diffusion of management knowledge, and directs particular attention to the quality of industrial management. Systematic education for management is asserted to be one of the chief steps required to assure Britain's industrial future, and neglect of this factor is interpreted the progress of science in terms of their own undertakings. The manifesto directs attention to the development of a science of management and points out that to an increasing degree men of high personal character and cultured vision are finding in management a sphere of high social service. They are using the resources and methods of science to raise the effectiveness of their contribution to the organisation and direction of industry.

WHILE on this side the application of scientific methods to the functions and processes of business organisation promotes greater efficiency, establishes standards, and replaces haphazard effort by the deliberate pursuit of predetermined objectives, management is also an art involving co-operation and understanding of the human factor, so that acceptance of the scientific principles and loyal co-operation in the plans of the organisation may be secured from all its members. Skill in technique; knowledge of workshop practice; sympathy with the human factor; a receptive mind and an international outlook—these elements combine to produce a type of management which represents both in purpose and in method a second industrial revolution. Attention is directed to the assistance which statistical science can give in the higher control of industry, whether in budgetary matters, departmental co-operation and responsibility, planning of sales and production or costing methods, and it is pointed out

that such developments incidentally justify the increased application of technical research in industry. The manifesto concludes with emphasising the need for consolidation in the management field. Asserting that nothing short of a revolution in the general attitude to the operation of industry is needed, it appeals for serious co-ordination of efforts in this field both in the study of management science and in the exposition of its results, so as to raise the standard of management everywhere in industry.

The Case for Alcohol

IN a monograph entitled "In Chase of Truth of Alcohol", issued by the True Temperance Scientific Committee (Donington House, Norfolk Street, London, W.C.2. 1s.), Prof. H. E. Armstrong gives a vigorous popular exposition, couched largely in parabolic and allusive language, of the origin, relationships and uses of alcohol. In the dedication he states his conviction that in our attitude towards alcohol "we should abolish Pecksniff as our leader and become sensible, like foreign nations". He points out that while vineyards are going out of cultivation and the mash tun is shrinking, the cider-press is advancing in favour: the apple is becoming the rival of John Barleycorn. Taking a broad view of the position, alcohol and opiates (narcotics) have been alternatives throughout history: at the present day "the drunkard no longer disfigures society, but the nuisance of tobacco is everywhere and inescapable". Prof. Armstrong pictures tobacco as a powerful depressant, both of eyesight and of intelligence. Further, while the excessive indulgence in tobacco has induced in this generation a loss of appreciation of good cooking, alcohol has the opposite effect.

THE problems of nutrition and alcohol are inseparable, states Prof. Armstrong. The case against the reasonable use of alcohol as a beverage rests largely upon unsound experiments; when taken in moderation at meals, alcohol exerts a favourable effect upon digestion. Constant indulgence in large quantities of dilute alcohol leads to obesity, owing to the effect upon fat metabolism of the lower concentration within the cells, determined by the influx of alcohol. Since the Oriental dietary is near the margin of safety, the artificial ingestion of water induced by the use of alcohol would probably favour downgrade changes and so inhibit the repair of tissues. The proportion of alcohol oxidised in the body is small, but it has a definite metabolic fuel value. As a source of mechanical energy, alcohol is a serious rival to petrol. "To the chemist, alcohol is no mere drug . . . it is a wondrous material, a true elixir of life; the abuse lavished upon it is rarely otherwise than the abuse of ignorance. The fault lies with those who misuse it—these must be set aside, not alcohol."

Early Publication in Anthropology

Two notes, pregnant with suggestion for the field archaeologist engaged in palaeolithic research, appear among the communications presented to the Institut français d'Anthropologie last session (*L'Anthropologie*, T. 42, Nos. 5-6, pp. 679-682). As they indicated lines

of search in connexion with matters which, it is suggested, may hitherto have escaped the attention of excavators, it was important that their publication, in however brief a form, should have been as speedy as possible. In one note, the Abbé Breuil described a spear-point of bone of Mousterian age from the cave of Castillo (Santander). No object in bone of this type of Mousterian age was previously known, except an example found by Dr. H. Martin at La Quina in 1913. M. Breuil suggested a resemblance to the wooden spear found by Mr. Hazzledine Warren, associated with a Clactonian industry, at Clacton-on-Sea, and pointed out that such finds as this indicated that the Mousterians were in fact acquainted with the working and polishing of bone. This note was followed by a second, by Dr. Martin, in which he described the bone point of Mousterian age found at La Quina and also a point, or rather poignard, made from the canon bone of a horse, which had been found in 1905. Before the discovery of this latter, bone work by the Mousterians was not known. He suggested that the rarity of Mousterian bone work was due to the fact that the deposits, in which Mousterian remains were found, were not favourable to the preservation of objects of bone, or these were not recognised by excavators. In view of the importance of these announcements, it is most unfortunate that although they were presented to the Institut at a meeting held in February last year, the report has only just been published.

International Geological Congress

THE postponed sixteenth session of the International Geological Congress will be held in Washington this year on July 22-29. A long series of excursions has been organised for the period July 9-August 30, and it has fortunately been possible, through the generous assistance of the Geological Society of America, to offer the longer excursions at a considerable reduction below the actual cost. In selecting participants, where the number is to be limited, preference will be given to geologists whose special interests accord with the major objects of the excursion, and to geologists from foreign countries. Two important changes in the arrangements should be noted. The period covered by the excursions and the general sessions now falls entirely within the summer vacation of British and European universities. The resource topic originally chosen, "Petroleum Resources of the World", has now been dropped in favour of copper resources, and authoritative papers bearing on this subject are invited with the view of the publication of a special volume. Full particulars of the conditions of membership, topics for discussion, and itineraries and costs of excursions are given in the third circular, which can be obtained, together with application forms for membership, from the General Secretary, Sixteenth International Geological Congress, United States Geological Survey, Washington, D.C.

International Congress of Physical Chemistry

ON the occasion of its twenty-fifth anniversary, the French Society of Physical Chemistry is arranging

an International Congress of Physical Chemistry to meet in Paris in the third week of October of this year. Foreign scientific societies have been invited to collaborate. In addition to the usual receptions, banquets, etc., a series of discussions are being organised, dealing with outstanding physico-chemical problems, such as electronic conduction in metals and its relation to electrochemical phenomena. Communications upon this and other questions have been invited from eminent men of science in France and in foreign countries. These will be discussed at the forthcoming conference and will be published afterwards by the Société de Chimie Physique. Further information concerning the Congress may be obtained from Dr. Ch. Marie, 9 rue de Bagneux, Paris, 9e.

Mercury Arc Rectifiers

IN the *Brown Boveri Review* for October a very impressive list is given of the mercury arc rectifiers for power transmission which the firm has shipped to overseas countries. We are glad therefore to learn that these important devices for converting alternating into direct current are now being made in Great Britain by several manufacturers. For shipping abroad it is necessary that apparatus be provided with spare parts. For rectifiers these spare parts are made of porcelain, iron and steel. They cost little and can easily be kept in good condition. Two alternating current stations can be connected by a direct current link connected through two rectifiers. One rectifier converts A.C. to D.C. and the other converts D.C. to A.C. This arrangement is economical when the voltage at which power is interchanged through the link is high. This has led to the development of high-tension rectifiers. Pressures up to 50,000 volts have already been attained. Vacuum rectifiers are independent of the frequency. Mercury arc rectifiers do not operate at frequencies higher than about three thousand but from the practical point of view this matters little. It is probable that rectifiers may be used in the future for converting A.C. into D.C. for transmission along overhead wires, as difficulties arise in transmitting A.C. along these wires at full loads. If long-distance electrification of railways is ever adopted in Great Britain they would be most useful, for whatever systems are adopted by various companies, power on any other system can be transmitted to them and converted.

Meteorology in Southern Rhodesia

THE most recent Meteorological Report of the Department of Agriculture of Southern Rhodesia covers the year ending June 30, 1931. Included with it as an appendix is the Hydrographic Report for the years ending September 30, 1928, 1929, 1930 and 1931—a summary of rainfall and run-off for certain catchment areas in Southern Rhodesia, occupying four pages. The Meteorological Report contains the usual general review of the year, particulars of the climatological stations—which are all in the charge of voluntary observers or observers

attached to departments other than the Department of Agriculture—and numerous climatic tables, together with a few miscellaneous items, including a tentative essay in the preparation of seasonal forecasts of rainfall based on a number of factors, such as barometric pressure at Rio de Janeiro.

THE results obtained so far indicate a degree of success that would, if maintained, be of great economic importance in agriculture, but unless the correlation coefficient of +0.77 proves to have been an under-estimation of the degree of dependence of Rhodesian rainfall on the various factors from which it is being calculated, such successes will occasionally in future years be replaced by failures or partial failures. These should not, however, be frequent enough to make the forecasts useless to those with an intelligent appreciation of the proportion of success to be expected from given values of the correlation coefficient. Southern Rhodesia is one of those regions where the success of farming operations is very dependent upon a monsoonal rainfall that may seem ideal when the average only is considered, but which is capricious as regards its occurrence in individual years, and is too apt to occur in torrential downpours that result in an excessive loss to the soil through run-off at the surface. When farmers must face the lean years of deficient rainfall at a time of agricultural depression, it is not surprising that many fail and abandon their farms. This is mentioned in the Report as one of the factors contributing to a net loss of 32 observing stations in the eighteen months ending December 31, 1931.

Marine Biology in Ceylon

DR. JOSEPH PEARSON, in his Administrative Report of the Marine Biologist for the Year 1931 (Part IV: Education Science and Art (G). Colombo: Government Record Office, 1932), states that the year's inspection of the Ceylon pearl banks has not brought to light any new spat falls and as there are no mature oysters in large quantities at present, there is no prospect of a pearl fishery for at least another four years. The dredgings in the Gulf of Mannar, however, showed small patches of young oysters on practically all the paars, which is a promising sign for repopulation of the banks, as the heavy spat falls of 1921–24 followed a similar scattering of young oysters in 1920. During the diver's inspection of the pearl banks, in one or two places dense masses of *Avicula* spat were found attached to the *Sargassum* weed. This is known as 'false spat' and used often to be taken for the spat of the pearl oyster. The report also contains notes on the window-pane oyster fishery, chank fisheries and local fishing industries. Plans for development are sketched out and it is hoped that a fishing vessel of a modern type will soon be available by the aid of which it is proposed to carry out detailed investigations and research necessary to determine the best methods to be adopted for the bettering of the fishing industry by the introduction of modern fishing craft and modern fishing appliances.

Clothes and House Moths

A USEFUL pamphlet entitled "Clothes Moths and House Moths", by Major E. E. Austen assisted by Mr. A. W. McKenny Hughes, has recently been published by the British Museum (Natural History) as No. 14 in the Economic Series. The need for an authoritative publication, dealing with wide-spread pests of this kind, has been felt for a long time and the present pamphlet provides essential information as to the insects themselves and the best methods of dealing with them. Simple preventive measures are discussed as well as remedial treatments of a more drastic character. The pamphlet is well illustrated and includes the most up-to-date information available, free use being made of the valuable work carried out on these insects in recent years in both Germany and the United States. Applications for the pamphlet (price 6d.) made to the British Museum (Natural History), Cromwell Road, London, S.W.7, should be accompanied by a remittance, including postage (1d.).

Flood-lighting and Bird-life

SINCE late in the autumn of 1931 the great marble shaft of the Washington Monument in Washington has been flooded with strong light after dark, but it was only during the autumn just past that small birds began to be found dead at its base in the mornings (Science Service, Washington, D.C.). Several hundreds were picked up in a short time during the period of the southward migration, some merely stunned but others killed outright or so injured that they died. Flood-lighting on land gives rise to the same problem as lighthouses at sea, the birds in both cases being either attracted to the light or dazzled by the light so that they strike blindly against the structure. It seems unlikely that the destruction of the birds will result in the withdrawal of the flood-lights, for not only do they add to the beauty of the Monument, but they also serve as a guide and a warning to aeroplanes, which in approaching the commercial air-port just across the Potomac River were incommoded by the proximity of a pinnacle 555 ft. high.

Radium in Canada

In 1930 radium-bearing deposits of pitchblende rich in silver, were discovered at Labine Point in the Great Bear Lake area of the North West Territories of Canada. Since then, active prospecting has been carried on. The November issue of the *Canadian Mining Journal* contains an article by Mr. H. S. Spencer (of the Mines Branch), on the assays of samples of these ores. The analyses disclose two types of ore: (1) a pitchblende-quartz and (2) a pitchblende-carbonate mineralisation containing barytes and often rich in silver. Uranium-oxide contents ranged up to 60 per cent with averages of 43 per cent on bulk shipments. In view of the high cost of radium, the importance of these discoveries needs no emphasis. (See also NATURE, Dec. 17, p. 924.)

Announcements

THE Ostwald memorial lecture of the Chemical Society will be delivered by Prof. F. G. Donnan in the Chemistry Lecture Theatre at the University of Liverpool on January 27 at 6 P.M.

THE following appointment has been made by the Secretary of State for the Colonies to the Colonial Agricultural Service: Mr. G. C. Stevenson, to be assistant botanist, Central Cane-breeding Station, Barbados.

THE twenty-fourth Kelvin lecture of the Institution of Electrical Engineers will be delivered by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, on April 27 at 6 P.M. The title of the lecture will be: "The Travel of Wireless Waves".

IT is announced in *Science* of December 23 that in view of the death of Prof. Louis W. Austin in July, 1932, Prof. A. E. Kennelly has been elected to the presidency of the International Scientific Radio Union (Union Radio Scientifique Internationale) to succeed the late General Gustave A. Ferrié.

A COURSE of lectures on some aspects and problems of medical and industrial psychology will be given at the London School of Hygiene and Tropical Medicine on Mondays and Wednesdays during the present term. The lecturers will be Prof. M. Culpin, Mr. Eric Farmer, Prof. M. Greenwood, and Dr. May Smith. The first lecture, a historical introduction, will be given by Prof. Greenwood on January 16 at 2 P.M. The course is primarily intended for students taking the diploma in public health or the diploma in industrial psychology of the University of London.

M. ALBERT PORTEVIN, president of the Society of Civil Engineers of France, will give the next annual May Lecture of the Institute of Metals. M. Portevin has chosen as the title of his discourse, "Quenching and Tempering Phenomena in Alloys". The lecture will be delivered on May 10 at the Institution of Mechanical Engineers, Storey's Gate, Westminster, commencing at 8 p.m. Visitors are invited. Cards of admission are obtainable from the Secretary of the Institute of Metals. The Institute, which this year celebrates the twenty-fifth anniversary of its foundation, will hold its annual general meeting in London on March 8-9.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A part-time lecturer in botany at the Chiswick Polytechnic, Bath Road, Bedford Park, W.4—The Principal (Jan. 18). A lecturer in organic chemistry at Auckland University College, New Zealand—The Secretary of the Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (Jan. 28). A professor of electrical engineering at the Heriot-Watt College, Edinburgh—The Principal (March 24).

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.]

Gonad-Stimulating Hormones in Hypophysectomised Animals

EXPERIMENTS previously reported^{1, 2, 5, 6} on the effect of gonad-stimulating hormones in hypophysectomised animals have yielded somewhat contradictory results, probably because the number of animals studied has never been large. One of us (H. S.) has recently hypophysectomised more than six hundred albino rats by a modification of the Smith technique, by means of which it has been possible to complete the operation within five minutes, with unusually low immediate mortality, and we wish to present here a preliminary report of our findings.

The testes of hypophysectomised male rats, whether immature or adult, undergo atrophy, with reduction both of germinal epithelium and of interstitial tissue; the epididymides, prostates, and seminal vesicles are also much reduced in size. Treatment with the anterior pituitary-like hormone of the human placenta ("A. P. L.")³ does not prevent degeneration of the germinal epithelium, but the interstitial tissue displays marked over-development, and there is consequently no atrophy of the accessory sex organs.

Noguchi⁴ says that, in the ovary of immature hypophysectomised rats under the influence of pregnancy urine or placental emulsions, the thecal cells proliferate, becoming in appearance like lutein cells, although no true corpora lutea are formed. He further states that in such cases sometimes continuous oestrus sets in. Evans⁵, however, thinks that a pregnancy urine fraction (prolan) cannot work at all in the absence of the pituitary, and bases on this his theory of prolan action. It seems to us that our own extensive experimental material proves beyond doubt that A. P. L. does act on the ovary of the hypophysectomised rat, though this action is not the same as in the normal. Immature hypophysectomised females treated with A. P. L. fail to come into oestrus, whereas hypophysectomised adult females similarly treated show continuous oestrus (vaginal cornification) for days and even weeks. Immature females which have been injected for five days or more with A. P. L., in order to induce precocious puberty, and have then been hypophysectomised, also respond to continued A. P. L. treatment with continuous oestrus. It is clear that the response of the hypophysectomised female to A. P. L. is conditioned by the state of the ovary at the time of operation.

We have confirmed the finding of others that hypophysectomy leads to atrophy of the thyroid, adrenal cortex, and gonads, and to cessation of growth (which last, however, does not occur immediately in rats weighing less than 50 gm. at the time of operation); these processes are not checked by the administration of A. P. L. Nevertheless, A. P. L. does cause the appearance of pseudocorpora lutea in the ovaries of females hypophysectomised before puberty, and it evidently evokes a secretion of oestrin from the shrinking ovary of the adult

hypophysectomised female, since ovariectomised hypophysectomised animals did not manifest an oestrus response.

We have also found that hypophysectomy of adult females, either immediately after parturition or later in lactation, leads very rapidly to retrogression of the mammary glands and failure of milk secretion; although maternal instinct is not impaired and the young still attempt to suckle until they perish. Neither control operations upon the sella turcica without removal of the hypophysis, nor ovariectomy, will lead to this failure of lactation.

We have also been able to confirm Smith's¹ finding that hypophyseal implants permit apparently complete replacement therapy; with alkaline extract of bovine hypophyses, we have obtained growth of hypophysectomised animals without checking the atrophy of the thyroid, adrenal cortex, and gonads.

J. B. COLLIP.

H. SELYE.

D. L. THOMSON.

McGill University,
Montreal, Canada.

Dec. 9.

¹ Smith, *Amer. J. Anat.*, **45**, 205; 1930.

² Wallen-Lawrence and Van Dyke, *J. Pharmacol.*, **43**, 93; 1931.

³ Collip, Thomson, McPhail and Williamson, *Can. Med. Assn. J.*, **24**, 201; 1931.

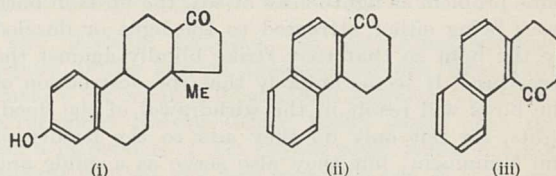
⁴ Noguchi, *Jap. J. Med. Sci. Pharmacol.*, **5**, 104; 1931.

⁵ Evans, *et al.*, *Amer. J. Physiol.*, **100**, 141; 1932.

⁶ Freud, *Deutsch. med. Woch.*, **58**, 974; 1932.

A Synthetic Oestrus-Exciting Compound

In conformity with the hypothesis, for which there is at present no experimental basis, that the ovarian hormones are formed by degradation of sterols, and in the light of recent developments in the chemistry of the sterols, ketohydroxy-oestrin is possibly represented by formula (i).



This accords with all the facts supplied by the work of Butenandt¹, Marrian², and others, and we decided that the arguments in favour of this formula were sufficient to justify attempts to synthesise compounds of this nature. By analogy with other physiologically active compounds, it seems likely that a whole group of substances of related chemical constitution will be found to have oestrus-exciting properties, and the synthetic production of such substances would probably be of considerable clinical value.

We have found that 1-keto-1:2:3:4-tetrahydrophenanthrene (ii), which we propose to utilise as a starting point in the synthesis of a substance of formula (i), has itself very definite oestrogenic action, although the dose required is very large in comparison with oestrin. The oestrus-producing activity of the substance was examined by the Allen and Doisy procedure. The technique followed was that described by Allan, Dickens and Dodds³. The material was dissolved first in olive oil, and later in sesame oil. It was found that the substances were not readily soluble in olive oil, with the result that large volumes had to be administered subcutaneously to the ovariectomised animals. This proved to be

unsatisfactory owing to leakage from the site of injection and intolerance to the oil, but with sesame oil the volume could be kept down to 2 c.c., and these adverse effects avoided. 25 mgm. of the substance in olive oil administered to ten ovariectomised rats produced no sign of oestrus, the animals remaining in a state of di-oestrus throughout the experiment. A batch of twenty animals injected with 50 mgm. dissolved in olive oil showed seven full oestrus responses, with three animals just short of the definition (a few leucocytes). In a series of twenty animals injected with 100 mgm. dissolved in sesame oil, a very much better response was obtained, all twenty animals going into oestrus. The oestrus in each case was complete.

In the case of the 50 mgm. dosage, oestrus appeared after 54 hours and terminated 150 hours after injection. In the case of the 100 mgm. in sesame oil, oestrus appeared after 52 hours. At the present moment, it is impossible to state the activity of the material in terms of oestrin since the relatively difficult solubility of the material together with the consequent difficulties of administration and absorption make a comparison impossible. Some form of 'cross-over' method must therefore be evolved. There can be no doubt that a repetition of the standardisation experiments with 50 mgm. dissolved in a small volume of sesame oil would indicate much greater potency than a similar experiment conducted with olive oil as the vehicle.

The observations show that 1-keto-1:2:3:4-tetrahydrophenanthrene is capable when injected into castrated animals of inducing oestrus of an exactly similar type to that obtained by the injection of oestrin. This result is of importance, for 1-keto-1:2:3:4-tetrahydrophenanthrene is the first compound of known chemical constitution found to have definite oestrus-exciting activity and furthermore, its molecular structure has many points of resemblance to the structure suggested for ketohydroxy-oestrin. There is thus provided the first step in the task of defining the molecular conditions necessary for this type of physiological activity, and there are grounds for hoping that substances of a much higher order of activity will be found before very long.

The observation⁴ that oestrogenic properties of a low order are possessed by suitable extracts of such a variety of materials as peat, brown coal, lignite, coal tar and petroleum is of interest, but in view of the fact that many such materials are known to contain carcinogenic constituents, the clinical use of such extracts without very stringent refinement is scarcely to be entertained.

We have also examined 4-keto-1:2:3:4-tetrahydrophenanthrene (iii) and 3-hydroxyphenanthrene; these gave no oestrus response when injected in doses of 50 mgm.

We are indebted to Dr. H. Allan for kindly checking over the animal experiments.

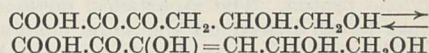
J. W. COOK.
E. C. DODDS.
C. L. HEWETT.

Research Institute,
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London, S.W.3.
Courtauld Institute of Biochemistry,
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¹ *Z. physiol. Chem.*, **208**, 129; 1932.
² *J. Soc. Chem. Ind.*, **51**, 277 T; 1932.
³ *J. Physiol.*, **88**, 348; 1930.
⁴ Schering-Kahlbaum: Fr. Pat., 710,857.

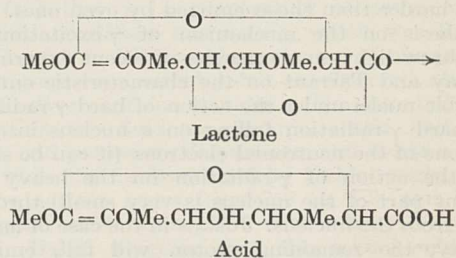
A New Unsaturated Derivative of Glucuronic Acid

Cox, Hirst and Reynolds¹ in investigating Szent-Györgyi's hexuronic acid, have suggested that this acid may have the following structures:



It will be noted that the second (enol) structure has a double bond. The acid reduces neutral silver nitrate, Fehling's solution, iodine and neutral permanganate², and yields a trimethyl ether and a triacetyl derivative.

In the course of recent work on glucuronic acid compounds of animal origin, we have methylated glucurone (the lactone of glucuronic acid) with silver oxide and methyl iodide, and obtained two crystalline methylated derivatives (see Pryde and Williams³), which were at first thought to be stereo-isomeric trimethyl glucuronates. Further investigation has shown that only one of these compounds was trimethyl glucurone (C₉H₁₄O₆, m.p. 131°-132°, [α]_D²⁰ +197.5° in water). The second crystalline compound was found to decolorise rapidly permanganate and bromine water, and analysis showed it to contain two hydrogen atoms less than trimethyl glucurone. It has been called trimethyl glucuralone (C₉H₁₂O₆, m.p. 88°, [α]_D²⁰ +110.8° in water), on analogy with the glucals since we regard it as possessing a 1:2 unsaturated linkage⁴ as follows:



Its formation is ascribed to the mild oxidising action of silver oxide during the course of the methylation procedure, further oxidation being, no doubt, prevented by the substituent methoxyl groups. The suggested structure affords certain analogies to the enolic formula now ascribed to adrenal hexuronic acid, in that our substance would appear to be an unsaturated derivative of an aldo-uronic acid having (as the lactone) three free hydroxyl groups.

JOHN PRYDE.
R. TECWYN WILLIAMS.

Physiology Institute,
Newport Road, Cardiff.
Dec. 13.

¹ *NATURE*, **130**, 888, Dec. 10, 1932.
² *Ibid.*, **129**, 576, April 16, 1932.
³ *Ibid.*, **128**, 187, Aug. 1, 1931, and *Jour. Soc. Chem. Ind.*, **50**, 959 1931.
⁴ R. T. Williams, Thesis, Univ. of Wales, April, 1932.

Mechanism of γ-Excitation by β-Disintegration

UP to the present, we have no system of relativistic quantum theory, and speculations about the process of emission of nuclear electrons may be permitted. In the recent work of Heisenberg, the stability of the nuclei relative to electron emission is treated on the basis of the energy balance conditions in such transformations. I propose to try

to give here a detailed picture of electron emission and the excitation of the nucleus connected with it.

According to the views now generally accepted, every nucleus is built up of a number of α -particles, neutrons, and, for the elements of odd atomic number, one proton. The α -particles, possessing no spin, must be all placed on the same energy level, while on the other hand the neutrons must be distributed between the different energy levels inside the nucleus, two neutrons on each. The proton, having the same mass as a neutron, must have inside the nucleus approximately the same energy levels (differing by a constant, if we normalise to zero the potential at infinity) and in this sense may be assigned to the first neutron level.

Suppose now that for some reason one of the nuclear neutrons is unstable, and, releasing an electron, is transformed into a proton. We may suppose that it will be a neutron from one of the upper energy levels, as in this case the work of extracting an electron from the nucleus will be less. After the electron has gone, the remaining proton will find itself on the high energy level, and will fall, emitting energy in the form of hard γ -rays. If such a process takes place when the nucleus already possesses one nuclear proton, a new α -particle is formed and the γ -energy emitted will be somewhat larger.

This view explains at once why the β -disintegration is so often (in contrast to α -disintegration) accompanied by high energy γ -spectra of great intensity, and why the γ -rays emitted by odd elements are much harder than those emitted by even ones. This hypothesis on the mechanism of γ -excitation can also throw light on the results of recent experiments of Gray and Tarrant on the characteristic emission of stable nuclei under the action of hard γ -radiation. The hard γ -radiation falling on a nucleus interacts with one of the neutronial electrons (it can be shown that the action of γ -radiation on the heavy constituent part of the nucleus is very small) throwing it out from the nucleus. Just as in the case of natural β -decay, the remaining proton will fall, emitting characteristic γ -lines.

To test this theory, it will be of interest to look for the trace of emitted electrons and for the difference between the behaviours of even and odd elements. As the experiments of Gray and Tarrant deal only with the even elements (oxygen, iron, tin, lead), the investigation of an odd element, say copper, will be necessary.

G. GAMOW.

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Leningrad.
Dec. 1.

Band Spectra which appear near Visible Triplet Lines of Mercury

RECENTLY, H. Kuhn¹ has found a band which appears very near the principal series lines of alkali metals in absorption and has explained this band as being due to the diatomic molecules loosely combined by Van der Waals' cohesion forces. In the case of mercury, it seems that bands of the same nature are also emitted very close to the visible triplet lines $2^3P_{0,1,2} - 2^3S_1$ which are not a principal series, in addition to the 2540 A. band beside the resonance line, and that these bands are well developed in the case of electrodeless excitation of the vapour with high-frequency oscillatory current.

In order to obtain a reliable spectrogram of such

faint bands near the strong emission lines, it was, of course, necessary to take various precautions to obviate 'ghosts' and hallations of the plate. One of the microphotometric curves of the spectrogram in the near region of every visible triplet line is reproduced as Fig. 1. The upper corresponds to that obtained from the tube of the so-called reflux condensation type excited by an electric current of 10^8 cycles and the pressure of the vapour was estimated to be about 1 cm.; while the lower corresponds to that from an ordinary alternating current mercury lamp cooled with an air blast, which is used for comparison. From the upper curve, it is easily seen that the bands *a* and *b* on the red side and the band *c* on the violet side of the main lines appear well in this condition of excitation, and the long wavelength side of the bands *a* which appear beside the

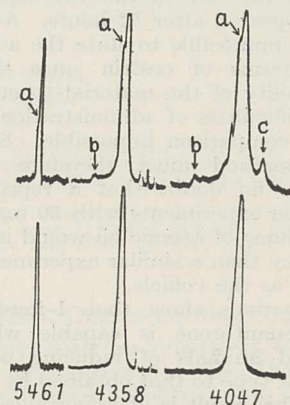


FIG. 1.

main lines are very sharply edged at 5467.7, 4362.6 and 4049.1 A. respectively. There are also to be observed several bands in the region between the sharp edges of the *a* band and the main lines such as the bands at 2540 A.² The wave-lengths of the *b* bands are measured as 4377.4 and 4053.1 A. respectively, while that of the *c* band is 4038.1 A. Other groups of bands of the same appearance are also observable in the neighbourhood of these triplet lines; whether they are connected with the lines or not is not clear. The maximum intensities are situated at 5492.7, 5483.6, 5473.5, 4364.8, 4064.1, 4060.8, 4050.4 and 4023.8 A. respectively.

E. MATUYAMA.

Sendai, Japan.
Oct. 23.

¹ H. Kuhn, *Z. Phys.*, **76**, 782; 1932.

² H. Kuhn and K. Freudenberg, *Z. Phys.*, **76**, 38; 1932.

Hyperfine Structure in Aluminium

FOLLOWING a suggestion of Prof. Paschen, that the hitherto unexplained doubling of several terms in Al II observed in his investigations of this spectrum¹ might be due to a nuclear moment, I undertook an examination of the structures of some aluminium arc and spark lines. The spectra were produced in a Paschen hollow cathode cooled by liquid air, following the method of Schüller. The tube was filled with helium. The lines were resolved with Fabry-Perot etalons which were silvered by evaporation for the visible spectrum and coated with Hochheim alloy for the ultra-violet spectrum. A reflection echelon was also used.

A very distinct hyperfine structure was found in the spark line λ 2669.166 ($3s^2$) 1S_0 - ($3s3p$) 2P_1 , the line being double with the weaker component about 0.2 cm.^{-1} to the longer wave-length side. This indicates a normal splitting of 2P_1 by a nuclear moment which is probably $\frac{1}{2} \cdot h/2\pi$. Entirely in agreement is the doubling of the arc lines $\lambda\lambda$ 6696.07 and 6698.73 ($3s^2 4s$) $^2S_{1/2}$ - ($3s^2 5p$) $^2P_{1/2,3/2}$ which are both split with a separation of about 0.04 cm.^{-1} due to the 2S term. Doubling is also clearly to be seen in the arc lines ($3s 3p^2$) $^4P_{5/2,3/2}$ - ($3s 3p 4s$) $^4P_{5/2}$ at 3057.155 and 3050.073 A. classified by F. Paschen². Fig. 1 shows the last mentioned lines as photographed at etalon separations of 10 mm. and 12 mm. In these lines probably both terms are split. Hyperfine structures in several other aluminium arc and spark lines have been observed, and the investigation is being continued.

Previous attempts to detect hyperfine structure in aluminium lines have been made by Gibbs and Kruger³ and by Tolansky⁴ who followed a suggestion of White⁵ that Gibbs and Kruger's negative results



FIG. 1. Fabry-Perot patterns of the aluminium arc lines 3057A. and 3050A. Above, 10 mm. plate separation; below, 12 mm. plate separation.

did not constitute complete evidence against the existence of a measurable fine structure in aluminium. He did not succeed, however, in resolving any lines of Al I and III. Preliminary photographs of the arc lines $\lambda\lambda$ 3944.025 and 3961.537 found simple by the previous investigators have been taken with the reflecting echelon and seem to indicate a splitting of these lines also. From the present results, it is seen that aluminium has a nuclear moment and a not unusually small $g(i)$ factor.

RUDOLF RITSCHL.

Physikalisch-Technische Reichsanstalt,
Berlin Charlottenburg.
Dec. 8.

¹ *Ann. Physik*, 4, 71, 537; 1923; and 4, 84, 1; 1927.
² *Ann. Physik*, 5, 12, 509; 1932.
³ *Phys. Rev.*, 37, 656; 1931.
⁴ *Z. Phys.*, 74, 336; 1932.
⁵ *Phys. Rev.*, 37, 1175; 1931.

Fixation of Mitochondria

DR. J. R. BAKER¹ has pointed out that, contrary to what has hitherto been accepted, mitochondria in animal tissues are not dissolved when lipide solvents and particularly acetic acid, are used in the fixative.

As regards plant tissues, Zirkle² states :-

(1) "Acetates do not give a basic fixation image and never preserve mitochondria."

(2) "Small traces of acetate will prevent the fixation of mitochondria regardless of the pH."

(3) "No matter how alkaline the acetate may be it never gives a basic fixation image. Always the hyaloplasm, nuclear lymph and mitochondria are destroyed. This is not only true when acetates are used alone but also when mixed with other reagents, for they penetrate so rapidly that they are the chief determiners of the fixation image."

(1) Using chromic acid 2.5 per cent, pH 1.0, he says :

"Mitochondria are nowhere preserved, though they are destroyed probably only in the outer part of the tissue, for when the fixed material is treated subsequently with CuCr_2O_7 (pH 4.6) some mitochondria are found in the central cylinder."

(2) Using potassium dichromate.

At pH 4.4, potassium dichromate containing no free acid gives a fixation image showing mitochondria in the outer part of the tissue, though owing to the slow penetrating power of the dichromate they are rarely fixed in the central cylinder. If the alkalinity of the dichromate be increased to pH 6.0, the fixation image shows mitochondria rather spherical in shape.

(3) Finally, according to Zirkle, the range of pH 4.2-5.2 in the use of dichromates is a "critical range". Fixation images on the acid side of this range show no mitochondria, while on the alkaline side the mitochondria seem to be quite well preserved.

I find that in a preparation of some root-tip material of *Althaea taurinensis*, which was fixed in La Cour's³ 2 BE for the purpose of chromosome count, numerous mitochondria are observed, although the fixative contains acetates. The essential fixing agents in this fluid are chromic, acetic, and osmic acids, and potassium dichromate, and it has a pH of 1.8, while the fixatives used by Zirkle ranged in pH in the acetate series from 3.6 to 6.2, and in the chromate series from pH 1.0 to 6.2.

Dr. Baker suggests that the mitochondria are insoluble in acetic acid when they have a high protein content. The difference in pH between La Cour's fluid and those used by Zirkle would indicate, however, that the pH of the fixing fluid may determine whether mitochondria are soluble or not in solutions containing acetic acid.

The result which Dr. Baker obtains for animal cells would therefore appear to be equally true of plant tissues, but for a different reason from the one he suggests.

J. HUGH DAVIE.

Botany Department,
King's College,
University of London.
Nov. 25.

¹ Baker, J. R., *NATURE*, 130, 741, Nov. 12, 1932.
² Zirkle, C., *Protoplasma*, 4, No. 2; 1928. Zirkle, C., *Protoplasma*, 5, No. 4, pp. 520, 528, 532; 1929.
³ La Cour, L., *J. Roy. Micro. Soc.*, 51, 119-126; 1931.

Dimensions of Fundamental Units

A GREAT simplification in electrical and magnetic dimensions which is not adopted by Prof. W. Cramp¹ or emphasised by Prof. F. M. Denton² is obtained by admitting that as we cannot determine experimentally the dielectric and magnetic constants of space, we have no right to introduce k_0 and μ_0 representing these hypothetical quantities into our equations and

should confine ourselves to the numerical k 's and μ 's of material media.

The omission of k_0 and μ_0 produces startling simplicity; the c.g.s. unit charge and unit pole both become 1 dyne¹ cm., the electrostatic unit of capacity becomes 1 cm., instead of 1 k_0 cm., and so on. Incidentally, I suggest that this method of indicating the dimensions of a physical quantity by giving one of the units commonly employed in measuring it has some advantages. The velocity of light in space, as the electromagnetic constant, c , comes naturally into all the equations connecting electrical and magnetic quantities—for example, the work done in taking a pole m round a closed path linking once with a current i is $4\pi mi/c$ —instead of being hidden away as $1/k_0 \frac{1}{2} \mu_0 \frac{1}{2}$.

This way of regarding electrical dimensions appears to me to be much better than the $\mu_0 k_0$ method and it is tacitly approved by all physicists who give capacities in centimetres instead of in k_0 cm. So far, however, I have only seen it formally adopted by German physicists.

As the writers of the letters quoted above have pointed out, fractional indices may be avoided by employing a unit of electricity as one of our fundamental units and writing, for dyne¹, c.g.s. unit charge per cm.

H. STANSFIELD.

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Southampton.
Dec. 22.

¹ NATURE, 130, 368, Sept. 3, 1932.

² NATURE, 130, 892, Dec. 10, 1932.

Catalytic Hydrogenation of Olefinic Compounds

IN a recent paper¹ it has been shown that the course of catalytic hydrogenation in a series of butadiene acids $R_1R_2C:CR_3:CR_4:CR_5CO_2H$ varies from member to member when the operation is carried out with a platinum catalyst at room temperature and atmospheric pressure. More recent work shows that the figures then recorded for the proportions of the components of the reduction mixture at the stage of 50 per cent hydrogenation are by no means to be regarded as characteristic of the respective acids, since by using an 'aged' catalyst the course of hydrogenation of sorbic acid, $CH_3CH:CH:CH:CH.CO_2H$, follows a course which is considerably different from that previously observed. Both the original and the new observations can be readily repeated.

The condition of the catalyst thus materially affects the relative extents to which $\alpha\beta\gamma\delta$ -tetrahydrogenation and $\alpha\beta$ -, $\alpha\delta$ - and $\gamma\delta$ -dihydrogenation occur simultaneously; consequently the nature and extent of substitution in the butadiene chains is not, under the conditions employed, the sole or apparently the most important influence in determining the course of reaction. The substitutional or constitutive influence (activating or deactivating) appears to be superimposed on a specific catalytic influence which of itself can activate both unsaturated centres of the conjugated system simultaneously.

Definite conclusions were reached several years ago by Lebedev and his collaborators² with respect to the order of reducibility (in competition) of (a) mono-, di-, tri- and tetra-substituted olefinic substances and (b) olefinic and conjugated di-olefinic substances. These conclusions, which were based

largely on the form of the hydrogen-absorption curves (rate/time) for binary mixtures of mono- and diolefinic substances, have now been rigidly verified, so far as numerous binary mixtures of Δ^α -, Δ^β - and Δ^γ -hexenoic acids, Δ^γ -pentenoic acid, allyl alcohol and sorbic acid are concerned, by chemical analyses of partial reduction products. Thus in the hydrogenation of sorbic acid, the whole of the conjugated acid disappears before the three isomeric ethylenic acids produced in the reduction suffer attack; moreover it is easy to follow quantitatively the disappearance, which proceeds at a constant rate, of the conjugated acid and the corresponding appearance of its saturated and ethylenic derivatives.

E. H. FARMER.

R. A. E. GALLEY.

Imperial College of Science
and Technology,
London, S.W.7.
Dec. 8.

¹ Farmer and Galley, *J. Chem. Soc.*, 430; 1932.

² Lebedev, Kobliansky and Yakubchik, *J. Chem. Soc.*, 417; 1925.
Lebedev and Yakubchik, *J. Chem. Soc.*, 832, 2192; 1928.

Rate of Burning of Colloidal Propellants

IN a paper¹ recently published by F. R. W. Hunt and G. H. Hinds, use is made of physical data quoted by ourselves in a previous publication² dealing with the general problem of the combustion of colloidal propellants. They draw conclusions which are directly at variance with our own in the case of three out of the four propellant compositions considered, in that they deduce for the rate of burning a pressure law, as against the temperature-density law advanced by us.

In analysing the data they have adopted the hypothesis that a formula given by us³, for assigning numerical values to the energy losses at the end of combustion, can when slightly generalised be applied to calculating the energy losses at any stage during the combustion. They have then proceeded to correct the pressure at each measured time interval, and in this way they have arrived at a hypothetical uncooled pressure-time curve (that is, the curve that would be presumed to have been obtained, had there been no energy loss at any instant during the explosion). From these values for uncooled pressure they have calculated corresponding fractions of charge burnt, and assuming no alteration in the time scale they have proceeded to apply a criterion to determine whether the rate of burning is proportional at any instant to their corrected uncooled pressure, or to their deduced gas density.

Such a procedure appears to be of doubtful validity. In the first place, the energy loss equation referred to was based on the assumption of a mean gas temperature holding throughout the burning, equivalent to that obtaining at the instant of complete combustion. This assumption was sufficient for the circumstances in which the formula was applied by us, namely, the assessment of the order of magnitude of a summation energy loss effect at the end of the explosion. A formula of this type, however, with an assumed average temperature and an appropriate fitting constant based on end conditions, cannot be used for assessing with sufficient accuracy varying temperature values during the burning for the purposes of any differential treatment, though it may yield values of approximately the right order of magnitude.

In the second place, even if for the sake of argument it be conceded that the formula may be put to such a use, the method adopted by Hunt and Hinds of calculating the value of the correction at each stage is open to objection. The main correction term depends on the value to be assigned to the fraction of charge burnt. This the authors have taken to be equal to the ratio of the observed pressure at any instant to the maximum pressure, an assumption which is unnecessary in view of the fact that they have available three equations by means of which the value of the fraction burnt, following their method, can be calculated, and the appropriate correction term deduced. Had they adopted this procedure they would have arrived at values differing from those they have actually employed.

Such difficulties always attend any attempt to deduce by differential methods the nature of the rate of burning law of propellants from experimental measurements of pressure and time only, and for this reason we have been led to investigate the possibility of ascertaining the temperature as well as the pressure at any instant during combustion. A technique for this purpose has been developed and experimental values are now being examined.

Although the analysis is not yet complete, the results so far available indicate that for the propellant compositions in question the rate of burning is in each case governed by a temperature-density law, and not by a pressure-law. We hope to be in a position shortly to publish details of our further investigations.

A. D. CROW.
W. E. GRIMSHAW.

Research Department,
Woolwich, S.E.18.
Dec. 13.

¹ Hunt and Hinds, *Proc. Roy. Soc.*, A. 138, 696; 1932.
² Crow and Grimshaw, *Phil. Trans.*, A. 230, 387; 1932.
³ Crow and Grimshaw, *Phil. Trans.*, A. 230, 54; 1931.

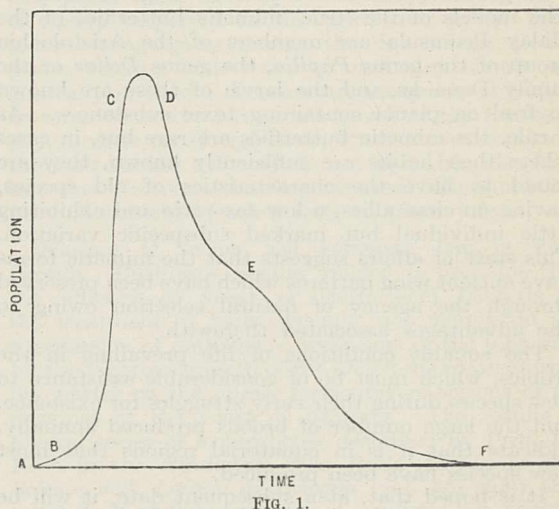
The Bacterial Growth Curve and the History of Species

WHEN a nutrient solution is inoculated with a species of micro-organism, in pure culture, the curve obtained by plotting the population against the time is characteristic and conforms to a general type of growth curve; an initial period of slow increase in numbers being followed by a rapid rise in population which, in turn, is superseded by a decline. An example of such a curve, representing the growth of a species of *Actinomyces* (measured by the evolution of carbon dioxide) in glucose solution,¹ is given in Fig. 1. Winslow² recognises five phases in bacterial growth curves: (i) phase of adjustment, A-B; (ii) phase of increase, B-C; (iii) phase of crisis, C-D; (iv) phase of decrease, D-E; (v) phase of readjustment, E-F: it is worthy of remark that the diminution in numbers following the period of crisis appears to be due neither to a deficiency in the food supply nor to the formation of toxic substances.

The examination of a variety of natural growth phenomena supports the view that this type of growth curve is fundamental and of universal occurrence. It may well be that the history of each living species, at all events of the terrestrial forms, is represented by such a curve when its natural evolution is undisturbed by such abnormalities as geological upheavals and the advance of civilisation.

Assuming a new species arises as a mutation in an existing species or an existing species enters a new

geographical zone, it would be anticipated that considerable difficulties would be encountered before the species becomes established, and this period would correspond to Winslow's phase of adjustment. During the phase of increase, which follows if the species can survive the initial stage, there will still be a considerable degree of instability which will be expressed in individual variation, and in this connexion it is relevant to note that H. D. and E. B. Ford³ found that, in an isolated colony of *Melitea aurinia* kept under observation for some years, an increase in the population corresponded to a marked incidence of variation. It is during this phase of increase that a species is most likely to extend its geographical range and also to give rise to new species, for the population is approaching a maximum and contains much highly variable material. With



micro-organisms, the phase of crisis, during which the population remains constant, is invariably of short duration although it does not necessarily follow that this is the case with all organisms; but it may be that this stage marks the disappearance of the tendency towards variability and the cessation of the production of new species. Nevertheless, it would seem that the major portion of the life of a species is occupied by the final phases of decrease and readjustment in which there is a gradual decline in numbers and little tendency towards variability.

If these conclusions are correct, a comparatively young species will be characterised by (i) much individual variation; (ii) no well differentiated geographical races; (iii) a number of closely allied species in the genus. On the other hand, a species which had entered the final phases would exhibit (i) little individual variation; (ii) well differentiated geographical races; (iii) few or no similar species in the genus. It has been found that the species of Malaysian Rhopalocera in which the sex ratio is abnormally low have the characteristics associated with old species.

Close observation of certain Indo-Malaysian species of Rhopalocera over a period of five years has revealed that, so far as they can be tested, the conditions amongst these insects are compatible with the conclusions stated above, but the case of migratory species has not yet been examined and probably requires separate consideration. The Indo-Australian genera *Eurema*, *Amathusia* and *Ambly-*

podia all contain a large number of very similar species and doubt still exists as to the status of certain species in the last two genera named. *Eurema hecabe* and *Amathusia phidippus*, the two most widely distributed members of their respective genera, both exhibit marked individual variation, the geographical races are not readily separable, the sexes occur in approximately equal numbers and both so closely resemble certain allied congeneric species that determination is frequently a matter of doubt and difficulty. On the other hand, species such as *Papilio brookiana*, *Pareronia valeria* and *Ideopsis daos*, in which the females are strikingly rare, have well-defined geographical races but exhibit little or no individual variation and have no close allies. Such instances can be multiplied.

Application of the views expressed here to mimicry amongst Malaysian butterflies is of great interest. The models of the 'true' mimetic butterflies of the Malay Peninsula are members of the *Aristolochia* group of the genus *Papilio*, the genus *Delias* or the family Danaidae, and the larvæ of these are known to feed on plants containing toxic substances. As a rule, the mimetic butterflies are rare but, in cases where their habits are sufficiently known, they are found to have the characteristics of old species, having no close allies, a low sex ratio and exhibiting little individual but marked subspecific variation. This state of affairs suggests that the mimetic forms have ancient wing patterns which have been preserved through the agency of natural selection owing to the advantages associated therewith.

The equable conditions of life prevailing in the tropics, which must be of considerable assistance to new species during their early struggles for existence, and the large number of broods produced annually, indicate that it is in equatorial regions that most new species have been produced.

It is hoped that, at a subsequent date, it will be possible to discuss the evidence which supports these arguments in greater detail than is permissible here.

A. STEVEN CORBET.

"Elm Lodge", Elm Road,
Earley, Reading.
Nov. 1.

¹ Corbet, A. S., *Rubber Research Institute of Malaya Journal*, 3, 16; 1931.

² Winslow, C. E. A., "Newer Knowledge of Bacteriology and Immunology" (Univ. Chicago Press), p. 56, 1928.

³ Ford, H. D., and Ford, E. B., *Transactions of the Entomological Society of London*, 78, 345; 1930.

Glycogen in Cartilage

WE were much interested in the letter from Prof. H. A. Harris in *NATURE* of December 31, p. 996, in which he directs attention to the presence of glycogen in hypertrophic cartilage cells and correlates this with a secretion of phosphatase by these cells.

We feel, however, that it should be made clear that phosphatase is also actively secreted by the osteoblasts^{1,2}. According to Prof. Harris, "osteoblasts and highly vascularised bone contain no glycogen". These facts are not necessarily inconsistent with the suggestion that he has put forward.

Prof. Harris in his letter refers to the hypertrophic cartilage as "senescent". Although hypertrophic cartilage, being a transitory structure, may eventually become senescent (degenerative), the process of chondroblastic hypertrophy is not in itself a degenerative change but a specific differentiation. One of us

(H.F.) formerly held the contrary view, but was forced to a change of opinion on finding that undifferentiated cartilage rudiments, when isolated and cultivated *in vitro* under standardised environmental conditions, only developed areas of hypertrophic cartilage if destined to do so in normal development, and only in that part of the rudiment where hypertrophy would normally have appeared^{2,3}. Degeneration may occur in small-celled cartilage *in vitro*, but in such tissue we have never found any histological appearance at all suggestive of the chondroblastic hypertrophy characteristic of an ossification centre. Moreover, the secretion of phosphatase in cultures of either hypertrophic cartilage or of osteoblasts is always correlated with a healthy condition and not with regression, as indicated by the fact that in unhealthy, though surviving cultures, one of the first cellular activities to disappear is the production of phosphatase.

H. B. FELL.
R. ROBISON.

Strangeways Research Laboratory,
Cambridge.

Lister Institute, London.

¹ Martland and Robison, *Biochem. J.*, 18, 1354; 1924.

² Fell and Robison, *Biochem. J.*, 24, 1905; 1930.

³ Niven, *J. Path. and Bact.*, 34, 307; 1931.

A Peculiar Visual Experience

IN *NATURE* of December 10 (p. 888) Dr. K. Mackenzie describes visual sensations consequent on the sudden subjection of his eyes to a brilliant flash. A similar experience of my own may therefore be worthy of record.

At the end of June, 1922, I was bicycling from King's Lynn to Leicester. It was a fine morning and the sun was of course behind me, when a motor-car, meeting me suddenly, unexpectedly flashed the sun from its wind-screen straight into my eyes. Shortly afterwards I seemed to see splashes of blood on the road. My sight was a bit troubled, but as the appearance was pronounced and persistent I dismounted to examine the road, and found that the red was in my eyes. Riding on I noticed that the red splashes had changed to green, which after a time died away.

I cannot estimate the duration precisely, but it was considerably longer than the ninety seconds noted by Dr. Mackenzie. The circumstances were not conducive to precise observation. The importance of the experience to me is that occasionally during the following years I have noticed brief repetitions of the appearance, generally taking the form of an irregular but defined blotch, and ending in white with a purplish border. It was apparently only the right eye that was affected, at least permanently, and about two years ago it became obviously difficult to read with it. It seemed that there was a lesion of the retina over the central area and this was confirmed by an oculist. The affection is most noticeable when rising in the morning or when looking from relative darkness into a bright light.

It is true that my eyes, especially the right one, have been subjected to fairly severe use throughout fifty years, but it is to this particular experience that I refer the damage, and I would suggest to Dr. Mackenzie that he should for the present rest his eyes as much as possible and consult an oculist without delay.

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London, S.W.19.

Dec. 14.

Research Items

Archæological Researches in the Argentine. At the time of his death in 1924 the late Dr. Eric Boman left in manuscript an account of his archæological investigations in La Rioja in 1914, in a series of papers which have now been edited and published by his colleagues (*Anales Mus. Nac. Hist. Nat. Bernardino Rivadavia*, Buenos Aires, vol. 35). These papers deal with excavations on several sites which produced a limited amount of skeletal material, interesting for the light it throws on the distribution of artificial deformation of the head, and a quantity of painted pottery with designs both geometric and conventionalised, as well as a number of figurines. The first paper of the series is devoted to a description of three sites or cemeteries in which were found a number of urn burials of infants. The skeletal remains were much decayed and little remained which could be submitted to osteological examination. From the teeth, however, it was possible to deduce that the range of age was from three months to about five years, or a little more; while Dr. R. Lehmann-Nitsche, to whom the skeletal fragments were submitted, was able to arrive at certain deductions as to the proportions of the long bones and the changes in course of growth as compared with Europeans. The pottery was hand-made, well-fired, and belonged in the main to two types. In form, the urns were either globular with mouth either circular or elongated, or bell-shaped. They were painted with a variety of conventional designs. Many of the pots had covers formed by inverted pots and a number, in addition to the skeletal remains, contained small pots or calabashes which probably had contained food or drink for the deceased infant. Small pebbles had been scattered over the bodies. Notwithstanding the distance between the cemeteries, the similarities point to an identity of race.

Fishes from the Tonga Archipelago. A small collection of fishes is described by Mr. Henry W. Fowler ("The Fishes Obtained by Lieut. H. C. Kellers, of the United States Naval Eclipse Expedition of 1930, at Niuafou Island, Tonga Group, in Oceania." No. 2931. *Proc. U.S. Nat. Mus.*, vol. 81, Art. 8. 1932). This is the basis for the first report ever published on the fishes of Niuafou Island, Tonga Archipelago. Two hundred and seventy-two specimens are represented by thirty-five species, three of which are new: *Paramysus Kellersi* (belonging to the family Echelidæ); *Salarias Kellersi* and *Salarias niuafoensis* (belonging to the family Blenniidæ). These new forms are figured in the text, the two *Salarias* species being very handsome additions to the genus, especially the latter, which has a peculiar and characteristic pattern on the upper lips and lower surface of the head extending under the chin as dark bands. The fishes altogether belong to seventeen families and twenty-five genera most of which have one or two species, *Salarias* having seven.

Land Leeches. Prof. J. Percy Moore, who has spent a season in India in the study of land leeches, contributes observations (*Rec. Indian Mus.*, vol. 34, pt. 1, 1932) on their biology, especially in the Darjeeling district and in Sikkim. The common small grass leech (*Hæmadipsa zeylanica montevidicis*) ranges in altitude from 800 ft. to 11,200 ft.; the range of other species is much more restricted. Prof. Moore states that the accounts of several previous observers represent land leeches as far more numerous than

they actually are. He examined every locality within reach where they were reported to be excessively abundant, but rarely did he find them to exceed six or eight per square foot. Only during July when the south-west monsoon was well advanced and young leeches were hatching in large numbers were 14-20 a sq. ft. counted in a few cases, and only rarely would several contiguous square feet yield so many; on many square feet none would be present. On 100 sq. ft. taken at random over an acre of good leech ground, the average was 1.8 a sq. ft. On this ground were places where leeches were present in such numbers as to give the impression of great abundance, but the largest number counted on one square foot was 13 and in places one might walk fifty paces unmolested by them. *H. sylvestris*, which is widely dispersed in the fields during the rainy season, congregates during the dry season at low places where a little water or mud may remain and generally in shade. Leeches are incapable of leaping as some observers have stated, and as the results of experiments on *H. sylvestris*, Prof. Moore concludes the land leeches not only do not swim but also have lost the effective swimming reflexes. He could find no evidence that leeches feed on plant juices.

Influence of Sodium and Potassium Ions in Yeast Growth. Buchner's results render it probable that the efficacy of yeast or lactic acid bacteria in the treatment of boils depends, not merely on the suppression of pathogenic organisms in the intestines by the vigorous growth of the added micro-organisms, but partly on the purely fermentative actions of the enzymes of the yeast or bacteria. The results of several series of experiments described by Prof. Ivo Novi in the *Rendiconti della Reale Accademia delle Scienze dell' Istituto di Bologna* (vol. 34) show that yeast itself and the enzymes it contains are affected differently by variations in the containing medium. The presence of 0.5 per cent of sodium chloride retards the development of yeast, and 3-6 per cent inhibits growth and favours autolysis. Multiplication of yeast is, however, accelerated by 0.5-2 per cent of potassium chloride, and as much as 5 per cent does not stop growth. The glycolytic power of yeast killed by heating at 100° C. is, however, activated by either sodium or potassium ions in the proportion of 1 per cent (as chloride), but if this concentration is raised to 3, 6, and 16 per cent, the effects on the glycolytic power are the opposite of those exerted on the yeast cells.

Trials of Fruit Trees. The very extensive trials of new varieties of hardy fruit trees carried out by the Ministry of Agriculture and the Royal Horticultural Society have produced a crop of extremely interesting results ("Trials of Varieties of Hardy Fruits for Commercial Purposes." *J. Roy. Hort. Soc.*, 57, pt. 2, pp. 246-286). Owners of new varieties of fruit which showed promise when exhibited at the Royal Horticultural Society's shows at Vincent Square were invited to send grafts, plants or cuttings to Wisley. They were propagated on suitable stocks and were distributed to a number of sub-testing stations embracing wide variations of soil and climate. It is now possible to form an exact estimate of the value of a new introduction for commercial use in any particular area. The trials include apples, pears, plums, cherries, currants, gooseberries, raspberries, blackberries, strawberries and nuts. Each variety

is estimated for yield, suitability for market, and resistance to disease and is compared with the performance of established varieties. Canning tests have also been made. Two interesting appendixes are added to the report. One states the most desirable characters of the various fruits for different purposes, whilst the other describes some of the varieties distributed for trial.

Silkstone Coal Seam of Yorkshire. Nowadays much attention is being paid to the problem of promoting the use of British coal and it is a legitimate criticism that the coal industry in its days of prosperity made little effort to accumulate and publish reliable data about its wares. Now the industry is fortunate in having this done for it by the State in its survey of coal resources. Survey Paper No. 25 (H.M. Stationery Office. 1s. 6d.) on the Silkstone Seam of South Yorkshire discloses a fuel of such high class as to deserve the greatest publicity. The seam is generally low in ash and moisture and the harder portion is justly celebrated as a house coal. The softer portions have all the most desirable properties of a coal for carbonisation either in gas works or coke ovens. In this respect its low content of alkali chloride is advantageous in minimising the destructive action of alkali on the refractories of carbonising plant.

Plan of Hochelaga. In the Italian translation by Ramusio of Cartier's "Voyages" published in 1556, there appeared a plan of Hochelaga, the Indian settlement adjoining the site of Montreal. This plan has since been accepted with deference and reproduced as authoritative, as in Biggar's "Cartier". In a recent paper (*Trans. Roy. Soc. Canada*, Section 2, 1932), Mr. W. D. Lighthall shows that the plan is not only misleading and contrary to Iroquois custom, but is also a fiction of Ramusio's engraver

and was probably never seen by Cartier himself. The plan showed a circular 'town' surrounded by a palisade of scantling and sawn planks unknown to the Indians. It showed square instead of elongated houses and a disposition within the stockade quite out of keeping with the arrangement known from Champlain's pictures of Iroquois towns. From Cartier's description of the town and its site, Mr. Lighthall has drawn a new plan and located its position on the map of modern Montreal. He gives Hochelaga an octagonal shape with a diameter of about 600 feet and places it immediately to the south of the McGill University grounds.

A Gaseous Oxidation. Ritchie and Ludlam (*Proc. Roy. Soc.*, Dec.) have studied the reaction between sulphur vapour at low constant pressure and oxygen at an initial pressure of about 4 mm. The reaction vessels were provided with independently heated inner tubes of quartz or pyrex glass. The oxygen disappeared from the reaction vessel when one of these surfaces was maintained at about 500°; and when the sulphur dioxide was rapidly removed from the reaction vessel the reaction once initiated continued after the inner tube had been cooled. The rate of the reaction was practically independent of the oxygen pressure. The process appears to be a chain reaction which is initiated at the hot wall. Sulphur dioxide is an inhibitor which breaks the reaction chains, and the steady progress of the reaction is controlled by the removal of the sulphur dioxide. When the oxygen pressure is raised, the diffusion of sulphur dioxide is hindered and the reaction velocity does not rise. The authors give a tentative explanation in terms of sulphur dioxide inhibition of the fact that the reaction always ceases while there is still a residual pressure of oxygen.

Astronomical Topics

Frequency of the Nova Phenomenon. Lund Observatory Circular for June 1932 contains a paper on this subject by Conrad Lönnqvist. He begins by noting the fact, first announced by Dr. Lundmark in 1923, and further confirmed by later research, that the absolute magnitudes of novæ at maximum are nearly constant, the weighted mean being -6.1 mag. The novæ in the Andromeda nebula exhibited the same phenomenon, and gave a measure of the distance of the nebula, 930,000 light-years, practically the same as Hubble's determination from the Cepheids.

Accepting this result, it is possible to deduce the distance of each nova from its apparent magnitude at maximum, and consequently to find the frequency of novæ in a given volume of space, which can be compared with the estimated number of stars in that volume. In this manner, he estimates that on the average each star undergoes a nova outburst about once in 400 million years. The general order of magnitude of this period is fairly well established, but it may need multiplication by a factor ranging from 3 to 1/3. The geological record is considered to make it evident that the sun has not experienced such an outburst in the last 1,000 million years. It is noted that the distribution of novæ along the galaxy is far from uniform, and it is conjectured that regions where dark nebulosity is present, notably Sagittarius, are more subject to such outbreaks. The distribution of novæ in the Andromeda nebula is stated, on Hubble's authority, to favour the suggestion: many of them are in the dark lanes.

Bright Lines in Stellar Spectra. The number of stars now known to possess bright hydrogen lines in their spectra is steadily increasing, and it has been suggested that some may have developed this characteristic within recent times. This fact, together with the difficulties encountered in theoretical explanations of such stars, and with the well-known variations which are frequently found, render observations of this type of spectrum of considerable importance. A useful list of *Be*-type stars has recently been published by Merrill, Humason, and Miss Burwell (*Astrophys. J.*, 76, 156) in continuation of a previous list which was published in 1925.

The number of such objects discovered at Mount Wilson Observatory is 233, of which 138 make up the later list. The method of search is to examine the $H\alpha$ line, which shows the effect most strongly. In some cases this is the only emission line present, and in all cases the intensity of emission decreases in the Balmer series towards the ultra-violet, the later members being simple absorption lines. The authors give the intensities of all the hydrogen emission lines, and of the dark ultra-violet lines, as well as a considerable amount of miscellaneous information. They find that bright $H\alpha$ and $H\beta$ lines reach their maximum intensities in stars of types $B0 - B3$; and another interesting fact which emerges is the existence of a reddening effect in some of the fainter stars which may be due to the absorption of light in space.

Annual Meeting of the Science Masters' Association

THE thirty-third annual meeting of the Science Masters' Association was held on January 3-6 at the University of Bristol. The programme consisted almost entirely of a number of lectures given by the heads of various departments of the Faculty of Science of the University. In addition, a large number of visits were arranged, including a very popular one to Clifton College, where the Science School was inspected.

In his presidential address, Prof. A. M. Tyndall, director of the Henry Herbert Wills Physical Laboratory, made a departure from the traditional form in that he gave what was virtually an experimental lecture on "Gaseous Ions". His aim was to avoid a highly specialised discourse on some physical topic in an endeavour to claim the attention of the biologists, while still maintaining the interest of the physicists by a judicious selection of experiments. For the most part, his demonstrations were performed with the most simple apparatus in order to provide material which might be easily adapted to school conditions. He illustrated the methods of production of ions by means of coloured powders and soap bubbles, the phenomena of conduction, and the variation of velocity of movement of ions with their radius. Of historical interest was the reproduction of an experiment of about 1740 due to Abbé Nollet. An electrostatic charge was conveyed by thermal ions, produced by the flames of two candles, along a piece of wood, from a Wimshurst machine to an insulated ball, which, on receiving the charge, attracted small particles of paper from the surroundings. After a group of demonstrations on high-speed ions and their ionising power, Prof. Tyndall discussed shortly current theories regarding the nature of cosmic rays. Their existence in the room, despite the lead roof, was shown by a process of magnification by a Geiger counter and a three-stage amplifier. A series of sharp notes on a loud speaker proclaimed their arrival. During a brief survey of the causes of atmospheric electricity, he performed an experiment supporting the old Simpon theory, and appropriately concluded with his "attempt at lightning" which he demonstrated last year to the "children's auditory" at the Royal Institution.

Prof. W. E. Garner, Leverhulme professor of physical chemistry in the University, lectured on the "Decomposition and Detonation of Solids". He pointed out that only in exceptional cases is the liberation of gas from the interior of a crystalline lattice possible. Such a fact is in agreement with the calculations of Kossel and Stranski, who have shown that reaction centres should occur chiefly on the edges and surfaces of a solid. Decomposition results in the formation of a new interface, and it is found that the rate of reaction is proportional to its area in irreversible processes, where there is no impedance by the products. This is illustrated in the case of lead azide and in endothermic changes generally. The reaction takes place when one ion absorbs sufficient energy to set it in vibration and so allow it to pass its energy to other ions by collision. The detonation wave is probably caused by four adjacent azide ions decomposing simultaneously. With lead styphnate and barium azide there is, in contrast, an initial induction period and decomposition occurs throughout the whole mass of the crystal. The change, which follows a simple exponential law here,

is a chain reaction with infinite chain length, and whereas detonation can only occur when the decomposition is accelerated, with lead azide it may take place at any stage of the reaction.

Prof. Sutton Pippard, professor of civil engineering, deliberately chose a comprehensive title for his talk, "The Contribution of Science in the Development of Aeronautics", in order that he might depict how the progress of aviation has depended solely on the close co-operation of science and practical engineering. The combination of the worker in pure science, who has no interest in practical results but can assimilate something of the engineer's outlook, and the engineer, who can appreciate the value of theoretical considerations and experimental research and give them some tangible form, has been a most powerful and happy one. From the inception to the first flight, advanced mathematical analysis and accurate experimental work must always be in contact. While admitting such a debt to science, Prof. Pippard emphasised, however, that the development not only in the theory of structures and elasticity, but also in meteorology, archaeological research and geographical survey, has resulted in no small measure from the study of aeronautics.

In his lecture on "Neuro Humoral Mechanisms", Prof. R. J. Brocklehurst, professor of physiology, showed that in several instances the results of nerve activity can be adequately explained by postulating the liberation of a chemical substance which intermediates between the nerve and the tissue which it innervates. Loewi has demonstrated the probability of acetyl choline appearing in the heart after vagal stimulation and Lewis has brought forward evidence that a vaso-dilator substance, a histamine-like compound, is produced locally at nerve endings in the cutaneous blood vessels on antidromic stimulation or as a result of local axon reflexes. It is this substance, and not the injurious agent in a mechanical manner, which stimulates the sensory nerve endings. Prof. Brocklehurst is to be congratulated on his choice of subject since it is becoming one of increasing importance, but as yet has found no place in current physiological textbooks.

"The Geology of the Bristol District" was the subject of a lecture by Prof. S. H. Reynolds, professor of geology. Besides possessing all formations with the exception of the Archæan, Ordovician, Permian or Tertiary, the district is fortunate in having two of the finest sections of carboniferous limestone (in the Avon Gorge and at Burrington Combe) to be found in Europe, or possibly the world. A special feature in the Mendips is the way modern erosion has reproduced most of the pre-Triassic topography.

So popular was the address given by Prof. M. W. Travers on "The Discovery of the Rare Gases" that many members were required to stand until further accommodation had been provided. Only three phases of the story were related—the discovery of argon and the separation and isolation of neon. Interest was enhanced by the many personal reminiscences, and by lantern slides showing the laboratories and apparatus used in the original research.

The lecture demonstration of Dr. S. H. Piper on "Laboratory Vacuum Technique" was concerned with modern developments and the methods now used, since such facts are more accessible to universities than to schools. He dealt particularly with the

alloy- and metal-glass seals now available, and prophesied the general use of low vapour pressure hydrocarbon oils, as prepared by Birch, in diffusion pumps. The demonstrations were of great beauty and special mention may be made of three—the method of preparing electrostatic screens *in vacuo* by distillation of metallic silver, the renewal of alkali metal traps by passing sodium ions electrolytically through soda glass, and finally the use of magnesium as a 'getter', the distillation being effected by means of electron bombardment.

The concluding address, the subject of which had been puzzling members for some time, was given by Dr. MacGregor Skene on "Charles and Erasmus". He was referring to Erasmus Darwin and his famous grandchild, who still remains, said Dr. MacGregor Skene, the greatest and best protagonist of his evolutionary theory.

The trade exhibition of apparatus and books was held in the Physics Department. There were many examples of good workmanship, especially the epidiascopes, which were displayed to full advantage in the optical laboratories. The bakelite

cases for balance weights were interesting. Of outstanding interest was the display of the cycle film by Messrs. Dance-Kaufmann. This formed the subject of a demonstration and discussion initiated by Mr. H. E. Dance. The value of such films was at once apparent in the illustration of the theory of wave motion, and of the three-phase induction motor. An advantage is that only one effect is illustrated at a time, hence the teacher never loses control due to excessive detail, as is often the case in documental films. The projectors, equally adaptable to continuous and stationary films, may be operated by hand, or, in the more expensive model, by an electric motor, and can be used in daylight. The conditions of the demonstration were, throughout, those likely to be found in the class-room. The manufacturers are desirous of producing additional films of an educational type and wish to have the co-operation of science masters in editing these.

The conference, which by general agreement had been one of the most successful of recent years, ended fittingly with a tour to Cheddar in most glorious weather.

F. C. TOMPKINS.

Lectures at the Physical Society's Exhibition *

MEASUREMENT OF SURFACE TENSIONS

THE first of the evening discourses associated with the Physical Society's twenty-third annual exhibition at the Imperial College of Science and Technology was delivered on January 3 by Dr. Allan Ferguson on "Surface Tension and its Measurement". Simple illustrative experiments were appealed to in order to demonstrate the existence of a surface tension in liquid films and surfaces, and the variation of this tension with temperature and with the nature of the liquid. Conditions of instability were illustrated experimentally, and it was pointed out that a knowledge of the *quantitative* laws governing these phenomena, together with an appeal to the principle of minimum potential energy, would go far to elucidate otherwise obscure phenomena.

Of the quantitative laws, the power law connecting surface tension and temperature, and Macleod's law connecting surface tension and density, together with the law of rectilinear diameters, give formulae which represent very closely the temperature variation of liquid and vapour density, and of free and total molecular surface energy.

Conditions of drop formation were demonstrated and the formation of aniline drops in water was shown by projection, and also by means of a slow motion cinematograph film. The impact on a solid surface of an aniline drop in water was also demonstrated cinematographically, as were some of Worthington's results for the impact of liquid drops on liquid and solid surfaces.

A brief discussion was given of the principal methods for the measurement of surface tension. Simple conditions for the production and photographic measurement of large flat bubbles were reviewed, and it was pointed out that the method can be successfully used for the measurement of interfacial tensions.

Quantitative determinations of the surface tension of benzene were made by the capillary rise method, by means of the pull on a plate, and finally, by a

method which involves the use of no more than a few cubic millimetres of liquid, a knowledge of its density being unnecessary. The methods were in each instance so arranged as to be direct-reading on scales visible to the audience.

CATHODE RAY OSCILLOGRAPHY

Mr. R. A. Watson Watt's lecture on January 4 at the Physical Society's Exhibition touched on a variety of aspects of cathode ray oscillography. He referred to 'domesticated oscillograms', the electrically-recorded gramophone record and the sound-track on the 'talkie' film, as illustrating the problems and limitations of oscillography, and then proceeded to discuss the special merits of the cathode ray oscillograph. It provides a radical solution of the opposing requirements of low inertia and high photographic effect which face the designer of mechanical oscillographs, it has an exceptionally high overload capacity, and the high-voltage type is ultimately limited in speed of operation only by the errors due to the finite time of transit of the indicating electrons through the deflecting field produced by the E.M.F.'s under examination.

Mr. Watson Watt showed slides of oscillograms, one delineating wave trains of frequency 25 million per second, corresponding to a wireless wave-length of 12 metres, and another of still higher frequency phenomena in which a trace described in 10^{-9} sec.—the time taken for light to travel 30 cm.—was clearly recorded. In this latter case the electron velocity in the recording jet was about half that of light, the transverse writing speed about one-fifth that of light.

Turning to the low-speed sealed-off oscillograph, Mr. Watson Watt enumerated the residual defects, mainly due to the gas content utilised as an aid to focusing, which still mar slightly the remarkably fine performance of modern tubes of this simple character.

The lecture was illustrated by demonstrations using eight oscillographs in all, a battery of five in parallel arranged around the lecture theatre, and three independent tubes of special construction. A demonstration of particular interest was the optical projection, throughout all the experiments, of the

* The lectures are being published in the February issue of the *Journal of Scientific Instruments*.

moving screen image from the central tube of the paralleled group on to a screen approximately two feet square, with a tenfold magnification. This projected image was clearly visible from the back of the theatre although an accelerating voltage less than 2,000 was used on the tube. There was a striking contrast between the red fluorescence of the 'port' member of the group and the brilliant green of the 'starboard' tube.

In addition to experiments showing the applications of the oscillograph in radio research, Mr. Watson Watt exhibited a cinematograph film from the same field. The most novel section of the film might, he suggested, be called "Sturm über Europa", as it represented a single minute of the thunderstorm history of Europe. The places of origin of individual atmospheric—located by simultaneous cathode ray cinematography on a base-line Slough-Leuchars—were indicated by bright flashes on a dark map of Europe, the timing of the flashes reproducing accurately the times of incidence of the individual atmospherics. The film showed that, within a single half-minute of recording, lightning flashes in mid-Atlantic, the North Sea, Denmark, Germany, Hungary, the Balkans, and France had contributed to the stream of atmospherics affecting Great Britain.

The lecture concluded with demonstrations of the variety of colour and duration of afterglow in screen materials, of the control of brightness by a Wehnelt cylinder, and of the applications of oscillographs fitted with Faraday cages to operations in which oscillographic response and relay control are combined.

The oscillographs used in the demonstrations were lent by the manufacturers, Messrs. A. C. Cossor, Ltd.

TIME MEASUREMENT: OLD AND NEW

The last of the evening discourses at the Physical Society's exhibition was given by Mr. Hope-Jones on January 5 on "Time Measurement: Old and New". With the kind permission of Sir Henry Lyons, the director of the Science Museum, he was enabled to begin his lecture by exhibiting the Dover Castle clock, still going, although a relic of the fourteenth century. He showed lantern slides of the half-dozen known examples of this period, de Vick, Wells, Cassiobury, Salisbury, Porlock and Dinan, and expressed the hope that others will be

found to have escaped the scrap-heap or restoration by a vandal clockmaker.

Mr. Hope-Jones traced the origin of the astronomical dial (a few of which survived the dissolution of the monasteries, such as Glastonbury, Wells, Wimborne and Hampton Court) from the Ptolemaic or geocentric conception of the universe, and showed models of Galileo's and Huyghens' escapements which harnessed the pendulum to wheelwork, thus bringing to a close the medieval period of 300 years during which the only known regulator for clocks and watches was the *Foliot* balance.

The halcyon days of English clock-making, inaugurated by Robert Hook, Harrison, Arnold and Earnshaw were discussed, and Mr. Hope-Jones deplored the fact that when Tompion and Graham were laid to rest in Westminster Abbey, the science of accurate time measurement died with them, or rather remained for two hundred years exactly in the condition in which they left it. He attributed this to the escapement, which had 'mesmerised' horology for so long, and showed how the "Synchronome" remontoire produces freedom of the pendulum by coupling two together as 'master' and 'slave', a feat accomplished by Mr. Shortt's invention of the hit-and-miss synchroniser.

The extraordinary effects of the new standard of time-keeping set up by this clock were rapidly reviewed: how it caused the astronomers to invert their methods of producing rate charts; how it revealed nutation and necessitated a revision of the definition of time in the Nautical Almanac, and finally how the lunar period appeared in comparison with the crystal clock, although the change in the value of G only affects the rate by $2/10,000$ sec. at maximum between lunar noon and midnight.

Prof. C. V. Boys has dubbed Mr. Hope-Jones as a modern Saint Athanasius, saying "this is the clock faith which, unless a man believe faithfully, he cannot be saved", subscribing to its articles himself, "with the possible reservation of some of its damnatory clauses". Whilst discouraging the use of the new synchronous motor clock for the time equipment of large buildings and institutions, Mr. Hope-Jones proclaimed the engineers of the electric light and power stations as the future time-keepers of the nation, and described means of assisting them to keep their turbo-alternators running true to average Greenwich Mean Time.

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held in London at the Institute of Education on January 5 and 6. The most notable features of the meeting were the presidential address by Prof. G. N. Watson and a discussion on "The Study of Statistics in a School Course". Prof. Watson's address had the mysterious title of "The Marquis and the Land Agent; a Tale of the Eighteenth Century". It was revealed as a topic from the history of mathematics. The speaker regretted that as a pure mathematician he could not speak on some popular subject from the 'real' world of the applied mathematician. Neither could a popular discourse be made on those researches into singular moduli which had engaged his leisure during the past two years. Pedagogical problems he regarded as of secondary importance. Only a historical subject remained.

The Marquis of the title was the Italian mathematician Giulio Carlo, Count Fagnano and Marquis de Toschi (1682-1766). English textbooks refer to him as Fagnano and mention a theorem concerning elliptic arcs. The 'land agent' was the English amateur, John Landen (1719-90) who was in the service of Earl Fitzwilliam from 1762 until 1788. His name is familiar in 'Landen's transformation' for an elliptic integral.

The tale uniting these two was their work on rectifying elliptic arcs and manipulating the corresponding integrals. In 1691, Bernoulli had discovered that it is possible to find arcs of a parabolic spiral which are of equal length but are not congruent. Fagnano obtained similar results for the lemniscate, and enunciated the general theorem that if m is an integer, a quadrant of the lemniscate can be divided into 2^m or 3×2^m or 5×2^m equal parts. Amongst his results occur rudimentary forms of the addition

theorems for elliptic functions. Many years later, Jacobi referred to the day on which a copy of Fagnano's works reached Euler as "the birthday of elliptic functions". Landen, in his "Mathematical Lucubrations" (1755) studied transformations of integrals, showing considerable ingenuity in obtaining forms convenient for calculation. This aspect was developed later by Legendre, Gauss and Ivory. Prof. Watson mentioned, in passing, that, in his opinion, mathematicians of the eighteenth century handled the technique of the calculus more skilfully than the technique of analytical geometry.

After this pioneer work, development took place on two very different lines. Legendre developed the elaborate, but unfruitful calculus of integrating expressions giving elliptic arcs, whilst thirty years later Abel and Jacobi developed the vastly more important concept of inverting such integrals, thus founding the theory of doubly periodic functions. One of time's revenges lies here. The first mention of this concept of inversion is in a manuscript by Gauss dated January 8, 1797. Had Legendre known of this, he would never have given the last part of his life to the futile labour of his "Traité des fonctions elliptiques". Yet Gauss's failure to announce his result was directly due to his treatment at the hands of French mathematicians when his memoir on arithmetical numbers was refused publication by the French Academy. After their humiliating refusal to publish this work, Gauss was loath to take any steps to publish during his own lifetime.

Prof. Watson mentioned some recent approximate formulæ for the perimeter of an ellipse, due to Peano (1887)—a mathematician usually associated with very different studies—and Ramanujan (1914). In connexion with his address an unusually complete exhibition of books on elliptic functions, arranged chronologically, had been compiled by Prof. Neville.

The discussion on "The Study of Statistics in a School Course" was opened by Mr. F. Sandon, headmaster of Plymouth Grammar School, who presented the unpopular view that the subject could have no place in the normal course. He suggested that the capabilities of pupils are so various and the intrinsic difficulties of the subject so real that little value

would result. Few teachers appear to know much of the subject. Statistical principles can be applied to modify some topics in the arithmetic course, such as the teaching of averages and graphs of statistics, but work beyond this, such as probability or correlation, is too difficult or laborious. Mr. Tuckey of Charterhouse and Mr. Wright of Winchester gave evidence flatly contradicting this. With an average middle school form, a course of two hours a week has proved possible and profitable at Charterhouse. Frequency curves, probability, dispersion and correlation have been studied with some seriousness. At Winchester, rather abler boys with no examination in prospect have covered a systematic textbook course as far as Spearman's "Foot-Rule" for measuring correlation. The balance of opinion of the meeting appeared to favour testing these opinions as to the possibility of teaching statistics in schools.

Other papers discussed various topics. Dr. Smart of Cambridge traced the history and importance of the precession of the equinoxes. Dealing with the importance of accuracy in observation, he mentioned the recent discovery of the work of the Rev. John Hornsby, an eighteenth century Oxford astronomer. From Hornsby's observations it is possible to obtain the data showing the motion of the perihelion of Mercury—a phenomenon that was not satisfactorily explained until the present century. Work in school was dealt with by several teachers. Mr. Boon of Dulwich pleaded for more use of side-tracks such as history and puzzles in elementary mathematics. Mr. Robson of Marlborough showed the possibilities of parametric representation in the specialist course. A keen discussion followed Mr. Siddons's paper on "Learning Theorems in Geometry". Mr. Siddons suggested that learning theorems is not valuable until pupils have some skill in solving riders. Mr. Piggott of Dartmouth put forward a more real method of teaching relative velocity than that current in textbooks. The device of 'reversing a velocity' was shown to be quite unnecessary. Finally, the Rev. D. B. Eperson of Sherborne concluded a most successful meeting with a diverting account of Lewis Carroll's work as mathematician.

Annual Conference of the Geographical Association

THE annual conference of the Geographical Association was held at the London School of Economics on January 4-6, and at the Imperial Institute, South Kensington, on January 7. About five hundred members took part, provincial and Scottish branches being particularly well represented.

The retiring president, Dr. H. R. Mill, chose as the title for his presidential address "An Approach to Geography". In fluent and easy language, yet with a precision too often absent from generalisations, he traced the progress of the modern concept of scientific geography. He emphasised the steady conquest by man of so many of the natural factors of his environment and the evolution of the world of to-day, which may thus be free and open to the movements of mankind. But man, in conquering the natural barriers, has erected in their stead artificial barriers in the form of frontiers with their tariff walls and innumerable other restrictions. Thus the geographer cannot ignore the new, though artificial, factors of the environment and his work must interlock with that of the economist. At the

same time, the problem is complicated by the fact that geographical factors are becoming more and more important in that, with the world improvement of transport and communications, it no longer pays a country to attempt the production of a commodity for which it is geographically unsuited.

This function of the geographer in helping to provide solutions for the complicated problems of the present day was further emphasised by Sir John Russell in his lecture on "Modern Changes in the Sources of our Food Supplies". One of the speakers at the annual dinner referred to geography as the 'most human' of all the sciences and to the appropriateness of meeting in the School of Economics, which was represented at the dinner by its director, Sir William Beveridge. The benefits to be derived from collaboration with allied sciences was further emphasised by a joint meeting with the Le Play Society, when an account of studies in Yugoslavia—the result of party visits led by himself and Dr. L. D. Stamp—was given by Mr. Arthur Davies.

The Association extended its welcome to Col.

Kenneth Mason, recently appointed professor of geography in the University of Oxford, who lectured on the exploration of the Himalaya, and to Lord Meston, whose first-hand account of contrasts in the Ganges basin threw many delightful sidelights on Indian geography.

The revival of interest in the land of Britain and its uses must inevitably be a feature of the next few years and the Association was given an account of the work of the Welsh Plant Breeding Station, Aberystwyth, in Prof. R. G. Stapledon's lecture on the improvement of hill grazings. A brief account was given of the progress also of the Land Utilisation Survey, now nearing completion.

Amongst the many meetings arranged for teachers, special interest was attached to the discussion of a model First Certificate examination paper drawn up by the Standing Committee of Secondary School Teachers. No new features not already commonly used in this examination were found suitable for inclusion, and suggestions made by some teachers present were nearly all negatived by others. Though taking little part in the discussion, a number of examiners were present and were doubtless relieved to find the meeting expressing the opinion that papers actually set by various examining bodies in recent years compare very favourably with the paper suggested by the Committee. Many teachers were clearly brought to realise the extreme difficulty of setting a paper to be answered by ten thousand candidates prepared by a thousand different teachers.

L. DUDLEY STAMP.

Calendar of Nature Topics

St. Hilary's Day. The depth of winter

January 14.—Although in the northern hemisphere the shortest day and least amount of insolation occur about December 21, the temperature of the air is maintained by the heat stored in earth and sea, and as this heat is given up, the average temperature continues to fall for nearly a month after the shortest day. This is expressed in the proverb:

"As the day lengthens,
So the cold strengthens."

The turn of the season is associated with St. Hilary's day in England and with St. Maur's day (January 15) in France. According to the smoothed ninety year averages at Greenwich, the coldest days of the year are January 12-14, all of which have the same mean temperature. The vagaries of our climate are, however, so great that in any one year the coldest day may fall on any date from mid-November to mid-March.

Winter Congregations of Birds

During January, Gilbert White noted the congregating of several species of British birds—in the order of their observation, skylarks, snow-buntings and chaffinches. He might have added, as equally characteristic of the season, fieldfares, redwings and mistle-thrushes, for the flocking together of the individuals of a species during the off-season when sex is at its lowest is a common occurrence. Of all the congregations, those of the chaffinch intrigued him most, first because the vast flocks which he saw contained many more birds than could be hatched in one neighbourhood, and secondly because the flocks seemed to be almost all hens. On the latter point he had been misled to some extent by Linnæus,

who, thinking that "before winter all the hen chaffinches migrate through Holland into Italy", leaving the cocks behind, named the species *Fringilla cœlebs*. Although there is no such independent migration, it is true that there is a tendency for chaffinches to group in flocks in which one sex predominates, but equally mixed flocks are common enough. As regards the excessive numbers in the winter flocks, the explanation is that while we retain our native stock—for our British-bred birds do not seem to migrate—there are added to their numbers, immigrants from northern and central Europe which remain in Britain from about November until May, and birds of passage which make a temporary sojourn in Great Britain during their progress towards, and return from, south-western Europe.

Movements of Winter Flocks of Birds

It is generally stated that the winter flocks of chaffinches in Britain are nomadic, wandering from one area to another in search of food, and although it is certain that such as the great immigrant flocks of wood-pigeons move over the country from one feeding ground to another as food supplies become exhausted, an American experiment suggests that more has to be learned about the detailed movement of the winter congregations. Crowned sparrows (*Zonotrichia*), on their winter migration, arrive in late September on the campus at Stanford University, California, and leave on their northward migration in late April or early May. A combination of ringing, trapping, and staining the feathers with a distinctive oil colour dissolved in carbon tetrachloride, so that the members of a particular flock could be recognised in the field, led to some interesting results (John B. Price, *Condor*, 1931, p. 238). In the first place, individual birds, after their summer migration to the breeding quarters, which range from British Columbia to Alaska, frequently return to winter in the same district and are usually recaptured even in the same trap. In the winter of 1927-28, 197 golden-crowned sparrows (*Z. coronata*) were ringed at Stanford, and in the following winter after a lengthy migration 28 per cent were re-captured there, and many more may have returned which were not trapped. In 1928-29, 120 golden-crowns were re-captured which had been captured (ringed or recovered) at Stanford the previous year. Of these, 96 were taken by the original trap and only 24 were re-captured exclusively at other traps, although the traps were quite close together. Here is an indication not only of a fine sense of locality, but also of a certain flock association which remains constant in successive winters in spite of the intervening break-up of the breeding season.

A second remarkable discovery, revealed by the trapping of ringed birds and confirmed by the movements of artificially coloured birds, a standard colour having been adopted for each flock, was that there was practically no interchange of individuals between flocks. Although the two traps concerned with two distinct flocks were but 100 yards apart, only one case of the crossing over of an individual occurred. Further, none of the stained golden-crowned sparrows was seen 600 yards from the staining trap and most were observed within 400 yards of it. It would seem that if territory dominates the breeding pair during spring and summer, it dominates the flock and not the individual during the winter, to such a degree that each definite flock has its own almost exclusive range of about 15-20 acres.

Societies and Academies

LONDON

Geological Society, Dec. 7. J. A. DOUGLAS: Geology of the Marcapata valley in Eastern Peru. The broad zone of Devonian rocks which runs north from Juliaca forms the bulk of the cordillera of Vilcanota, and there is little evidence of the existence of Upper Carboniferous deposits, which cover so wide an area in the region around Lake Titicaca. An underlying unfossiliferous black shale series, probably of Silurian age, is the chief formation in the cordillera of Carabaya. The intermontane region presents a vast accumulation of glacial debris, derived from the now shrunken glaciers of the Vilcanota knot, a group of giant snow-covered peaks which, from the evidence of morainic material, must be largely of volcanic origin. The eastern flanks of the range disclose a great diversity of metamorphic rocks, chiefly andalusite and cordierite-hornfels, penetrated by intrusions of typically alkaline biotite-microcline-granite; while at the head of the Marcapata Valley occurs an interesting suite of coarse-grained, basic, hornblende rocks, probably of hybrid origin, with associated pegmatites. Farther down the river, dynamically metamorphosed rocks are encountered—chiefly granitoid gneisses and amphibolites, with associated paragneisses of sedimentary origin. L. R. COX: Fossiliferous siliceous boulders from the Anglo-Egyptian Sudan. The paper describes a series of scattered eroded boulders of a hard, splintery, fossiliferous, chert-like siliceous rock found at two localities in the Berber district of the Anglo-Egyptian Sudan. Many of the boulders consist of rounded or sub-angular grains of opal or opal-derived chalcedony of various sizes with clear quartz and chalcedony in the interstices between them. On account of their large content of opaline silica it is considered that they are a product of secondary and probably surface silicification, and have been formed from, and within, a deposit once spread over the district. Except for one puzzling specimen which may be a fragment of a *Pinna* shell (a marine lamellibranch) and some obscure remains, apparently of plants, the fossils enclosed in the boulders are all non-marine gastropods. A Lower Tertiary age can be assigned with confidence to the fauna, on account of the presence of the genus *Pseudoceratodes*; the precise age may be Upper Eocene or possibly Lower Oligocene.

PARIS

Academy of Sciences, Nov. 21. CH. LALLEMAND: The world crisis and the gold standard. The author suggests the gram of gold as an international monetary standard, in which all financial contracts should be expressed. A. COTTON: Remarks on a note of M. Schérer on circular magnetic dichroism and magnetic rotatory dispersion. The author had earlier made experiments similar to those recently described by Schérer, but as the magnetic fields were only about one tenth those used by Schérer, no certain proof of circular magnetic dichroism could be obtained. The history of the subject is reviewed and discussed. GEORGES CLAUDE: The manufacture of commercial oxygen. A description of recent progress in the preparation of oxygen by the fractional distillation of liquid air, especially the improvements introduced by Frankl. J. SCHOKALSKY: The circumnavigation of the François Joseph archipelago by the north. An account of a voyage around this archipelago in a small vessel, the

Knipovitch (motor 125 h.p.) under Capt. S. Popov. The author's view of an improvement in the polar climate, possibly temporary, was confirmed. LUCIEN DANIEL: The variations of *Helianthus Dangeardi* at the fifth generation. BERTRAND GAMBIER: The congruence of circles: focal points and focal surfaces. LUCIEN CHAMARD: Certain singular points of ensembles equidistant from a point ensemble. MARCEL BRELOT: The trend of sub-harmonic functions in the neighbourhood of a point, singular or not. ARNAUD DENJOY: The characteristics of the tore. JACQUES DEVISME: Some applications of hypergeometric functions. G. BOURION: A class of Taylor's series. ROBERT L'HERMITE: Plane rectangular pieces of small thickness submitted to peripheral pressures situated in their plane. BERNARD LYOT: The direct observation of solar prominences at Meudon. The direct method of observing the prominences has advantages over the spectrohelioscope or spectroheliograph, but up to the present has only been used during eclipses. The possibility of directly observing the protuberances was proved by observations made on the Pic du Midi in 1930 and 1931. By a careful study of suitable screens it has now been found possible to make good observations at the Meudon Observatory. An exposure of one second gives a good solar image (8 cm. diameter) as against several minutes required by the spectroheliograph. Hence by means of kinematograph films it is now possible to study the complex movements of prominences. Y. ROCARD: The formation of negative ions according to quantum mechanics. I. I. AGARBICANU: The absorption of the fluorescent light of iodine by the same vapour. M. SCHERER: The circular magnetic dichroism and abnormal magnetic rotatory dispersion of solutions of cobalt chloride. Curves are given showing the ellipticity and rotations as functions of the wave-length. The large Bellevue electromagnet was used to obtain the magnetic fields. P. JACQUET: Study of the strains in electrolytic copper deposited in the presence of colloids. In a previous communication on the same subject the colloid used was gelatine: the present note describes similar experiments carried out with other colloids, serum albumin, gum arabic, gum tragacanth and dextrin. The results are summarised in graphs. H. FORESTIER: The influence of the magnetic field on the electrolysis of nickel salts. The rate of deposit of nickel by electrolysis in acid solutions diminishes as the strength of the magnetic field increases: in solutions of zinc or copper the magnetic field causes a slight increase in the velocity of deposit of the metal, due possibly to the influence of the convection currents of the electrolyte. PICON: Thorium sulphide. This sulphide can be prepared by heating the oxide, placed in a graphite boat, in a current of hydrogen sulphide at 1200° C. The reaction is complete after one hour, and the temperature is then raised to 1600° for thirty minutes. The product is thus melted and is free from oxygen and carbon. The physical and chemical properties of the thorium sulphide are given. MME. RAMART-LUCAS and MME. M. GRUMEZ: The colour and structure of oximes and semicarbazones. The absorption in the ultra-violet of oximes and semicarbazones shows that not only can these substances exist in two stereochemical forms, but also in two isomeric forms in which the functional group is different. CHARLES DUFRAISSE and RAYMOND BURET: Researches on the dissociable organic oxides. Extension of the methods for the preparation of the rubrenes. Application to the synthesis of a dichloridi-

phenylrebene, $C_{30}H_{18}Cl_2$. The practical preparation of this substance starting from dibenzoylmethane. S. GOLDSZTAUB: The crystalline structure of goethite. JACQUES FROMAGET: New observations on the geology of the stanniferous region of Nam Pha Thène (Laos). P. GEOFFROY: The probable age of the Doui series in the Middle Chélif (Algeria). CH. JOYEUX, J. G. BAER, and J. TIMON-DAVID: Researches on the evolutive cycle of the trematodes belonging to the genus *Brachylæmus*. HENRI JEAN FROSSARD: The measurement of the ventricular pressure by the pulsatory method. GEORGES BOURGUIGNON and SOCRATE ELIOPOULOS: The classification of different ions in natural chemical families by their vaso-motor action in trans-cerebral dielectrolysis. P. KUCHARSKI: Researches on the structure of the vowels. A. GIRARD, G. SANDULESCO, A. FRIDENSON, and J. J. RUTGERS: A new crystallised sex hormone. A new hormone, equilenine, has been isolated from the urine of pregnant mares. 1.5 gm. of the purified hormone were obtained from 52 tons of urine. It is a ketone of the composition $C_{18}H_{18}O_2$.

MELBOURNE

Royal Society of Victoria, Oct. 13. C. OKE: Australian Staphylinidæ. ALAN COULSON: Diabase rocks at the You Yangs near Geelong. Boulders of diabase are recorded from this locality; when examined microscopically they show uraltisation of a similar character to that of the epidiorite at Ceres and Dog Rocks; it is probably of Cambrian (Heathcoteian) age. The occurrence lies in an axial line passing through the Colbinabbin Range, Mount William and Ceres. ALAN COULSON: The older volcanic and Tertiary marine series at Curlewis near Geelong. This series of basalts and tuffs underlies Tertiary marine clays and limestones of a probable Janjukian age. Faulting and folding have affected the area and are illustrated in plans and sections of the beach and cliffs at Curlewis. Cause of earth movements not apparent, but are tentatively correlated with the (?) newer Pliocene tectonics of the Geelong district. W. M. HOLMES: The Mornington earth tremor of Sept. 3, 1932. The brief duration of this earth tremor did not permit the identification on the seismogram of the various phases of the earth waves with any degree of accuracy. The epicentre was therefore determined by two hundred replies received from a questionnaire prepared on a basis of the modified Mercalli scale of intensities. A numerical value was assigned to each locality, and lines and bounding areas of equal intensity were drawn on the map. These lines indicated an epicentre at $38^{\circ} 15' S.$ and $145^{\circ} E.$, a position west of Mornington in Port Philip Bay.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. G. A. CROCCO: The stability of 'instrumental' flight. The problem of the stability of an aeroplane in 'blind' flight may be defined by three equations treating of the perturbed motion of the baricentre, and by three 'instrumental' equations controlling the perturbed motion about the baricentre. G. ARMELLINI: Some theorems on the problem of two bodies of decreasing masses. Q. MAJORANA: A new photoelectric experiment. When exposed to the action of an intense pulsating radiation, very thin sheet metal undergoes an appreciable increase in its electrical resistance which does not appear to be due solely to the thermal action of the light. The results of experiments with silver thin enough to

show a distinct blueish transparency indicate that, under the conditions mentioned, the resistance of the metal is subject to pulsation, the mean value being somewhat greater than that observed in the absence of the light. T. BOGGIO: The curvature of lines of varieties. Various relationships—some of them not previously observed—between the curvature and torsion of a geodetic and the curvature of one of its plane projections, are deduced. H. CHAPIRO: The transplantation of the parallel transport. L. LABOCCETTA: The effective integration of discontinuous functions (2): Reduction to normal types and fundamental integrals. All ordinary discontinuous functions may be reduced, without altering the value of their integrals, to certain fundamental types which admit of easy integration. G. LAMPARIELLO: The equation of the transverse vibrations of an elastic rod supported at its ends. W. S. URBANSKI: The integration of Hamilton's equations for infinite time. V. HLAVATY: Differential projective invariants of a curve in the projective space P_{n-1} ($n = \text{or} > 3$). B. SEGRE: The conditions for the regularity of a linear system of forms. M. CRMINO: The laws of the areas of an Einsteinian motion considered in ordinary Euclidean space. G. AGAMENNONE: The supposed repercussion, at the antipodes, of the eruption of Krakatoa in 1883. R. EINAUDI: Magnetic behaviour of the oxygen molecule. The magnetic behaviour of the oxygen molecule in fields of the order of magnitude of 10^4 gauss is studied theoretically, and the results of experiments by Schürmann on magnetic deviation are found to be justified on theoretical grounds. P. STRANEO: The unitary theory and absolute geometrisation. G. C. WICK: The motion of an electron in a crystalline lattice. Taking into account the resonance forces due to the identity between a conducting electron and the bound electrons of the lattice, the energy levels of an electron in a lattice are calculated as a first approximation. A relative maximum of the energy for zero velocity of the electron is revealed. C. ANTONIANI and F. ZANELLI: Investigations on the cholesterol of the human brain. The molecular magnitude and the percentage composition of human cerebral cholesterol are the same as those of biliary cholesterol. Whether obtained from the foetus or from the adult, the cholesterol of the brain and certain of its derivatives exhibit slightly higher melting points than the product from the bile, and similar differences are observed in the specific rotation. These results are not, however, regarded as evidence of the non-identity of the two cholesterols. A. BARONI: Lithium alloys. (1) Thermal and X-ray analysis of the system lithium-tin. The diagram of state derived from the thermal analysis indicates the existence of the three compounds, Li_4Sn (M.P. 684°), Li_3Sn_2 (M.P. 483°) and $LiSn_4$, and of three eutectic points at 458° , 320° , and 214° , corresponding respectively with 35, 58, and 94 per cent (atomic) of tin. The X-ray analysis permits of the identification of the compounds $LiSn_4$ and Li_3Sn_2 , but the photographs obtained by the powder method do not allow the structures of these compounds to be calculated. F. SCARSELLA: The diffusion of the strata with *Posidonomya alpina* in the Central Appennines. A. CAVINATO: Thermal expansion in crystals and Haüy's law. The validity of Haüy's law for a crystal expanded by heat is demonstrated. B. MONTEROSSO: Cirrepedological studies (9). Anærobiosis in *Chthamalus stellatus* Ranzani. GABRIELLA PASTEGA: Power of recovery and growth of the cyclopean eyes of 'lithium' embryos of *Rana esculenta*.

Forthcoming Events

Monday, Jan. 16

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. L. J. Spencer: "Meteorite Craters as Topographical Features of the Earth's Surface".

KING'S COLLEGE, LONDON, at 5.—Prof. G. Temple: "The Principle of the Quantum Theory".

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. E. Bayliss: "The Respiratory Functions of the Blood" (succeeding lectures on Jan. 20, 23 and 27).

Tuesday, Jan. 17

ROYAL INSTITUTION, at 5.15.—Prof. J. C. McLennan: "Low Temperatures and Low Temperature Phenomena" (succeeding lectures on Jan. 24, 31, and Feb. 7).

Wednesday, Jan. 18

UNIVERSITY COLLEGE, LONDON, at 5.30.—H. M. Adams: "Bibliography in Cataloguing".

ROYAL SOCIETY OF ARTS, at 8.—Olaf F. Bloch: "Recent Developments in Infra-Red Photography".

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—(Annual General Meeting). Mr. Conrad Beck (Presidential Address): "Microscope Illumination with Transmitted Light".

ROYAL METEOROLOGICAL SOCIETY, at 7.40.—(Annual General Meeting). Prof. S. Chapman (Presidential Address): "Atoms, Molecules and the Atmosphere".

Thursday, Jan. 19

ROYAL INSTITUTION, at 5.15.—Prof. J. B. S. Haldane: "Recent Advances in Genetics" (succeeding lectures on Jan. 26, Feb. 2 and 9).

Friday, Jan. 20

ROYAL INSTITUTION, at 9.—Sir William Bragg: "The Crystals of the Living Body".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. W. W. Gregg: "The Descent of Manuscripts" (succeeding lecture on Jan. 27).

UNIVERSITY OF LONDON (at University College Hospital Medical School, University Street, Gower Street, W.C.2), at 5.15.—Prof. Max Bergmann: "The Chemistry of Proteins" (succeeding lectures on Jan. 23 and 24).

Official Publications Received

GREAT BRITAIN AND IRELAND

British Industries Fair, 1933, Olympia and White City, London, February 20th to March 3rd. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+Ad. xvi+504+Ad. 164. (London: Department of Overseas Trade.) 1s.

Royal Society of Medicine. Report of the Committee appointed by the Section of Otolaryngology for the Consideration of Hearing Tests. Pp. 33. (London: Longmans, Green and Co., Ltd.) 2s. 6d.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 43, Part 4. Pp. 277-372+plates 16-22. (London: Edward Stanford, Ltd.) 5s.

Forestry Commission. Report on Census of Production of Home-Grown Timber, 1930. Pp. 13. (London: H.M. Stationery Office.) 3d. net.

Two Lectures on The Nature of Simple Molecules and of Elementary Processes. By A. J. Allmand. Pp. 57. (London: Institute of Chemistry.)

Torquay Natural History Society. Transactions and Proceedings for the Year 1931-32. Vol. 6, Part 2. Pp. 83-172. (Torquay.)

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1931-32. Pp. 16. (Leeds.)

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 8: The Communist Policy towards the Peasant and the Food Crisis in the U.S.S.R. Pp. 24. (Birmingham: The University.)

Journal of the Chemical Society. December. Pp. iv+2809-2999+vi. (London: Chemical Society.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (N.S.), No. 11, November. Abstracts Nos. 1952-2168. Pp. 363-398. (London: H.M. Stationery Office.) 1s. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 28: The Anatomy of the Tortoise. By Dr. J. Stuart Thomson. Pp. 359-461+plates 19-43. 8s. Vol. 20 (N.S.), No. 29: Effect of the Conditions of Storage on the Vitamin D Potency and on

other Features of Codliver Oil. By E. J. Sheehy. Pp. 463-468. 6d. Vol. 20 (N.S.), No. 31: On the Colloidal Calcium Phosphate of Milk. By G. T. Pyne and J. J. Ryan. Pp. 471-476. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

OTHER COUNTRIES

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 52: La faune de l'Assise de Winenne (Emsien Moyen) sur les bordures méridionale et orientale de bassin de Dinant. By Eug. Maillieux. Pp. 102+5 plates. Hors série: Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 11: Alcyonaria. By Miss L. M. I. Dean. Pp. 24+4 plates. Vol. 2, Fasc. 12: Madreporaria, Zugleich ein Versuch einer vergleichenden Ökologie der gefundenen Formen. By M. E. Thiel. Pp. 177+21 plates. Vol. 3, Fasc. 12: Myriopoden. By C. Attems. Pp. 34+6 plates. Vol. 4, Fasc. 3: Heterometabola II. 1: Odonata, by F. C. Fraser; 2: Orthoptera—Acrididae, by C. Willems. Pp. 55+1 plate. Vol. 6, Fasc. 1: Algues. By Mme. Dr. A. Weber-Van Bosse. Pp. 27+5 plates. (Bruxelles.)

India: Meteorological Department. Scientific Notes, Vol. 5, No. 4: Tables extending Walker's Criteria and for finding the Chance of Success of a Forecast. By Dr. S. R. Savur and S. Gopal Rao. Pp. 31-39. (Calcutta: Government of India Central Publication Branch.) 6 annas; 8d.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 552: Annual Report of the Director of the Coast and Geodetic Survey to the Secretary of Commerce for the Fiscal Year ended June 30, 1932. Pp. iii+32. (Washington, D.C.: Government Printing Office.)

U.S. Geographic Board. First Report on Foreign Geographic Names, 1932. Pp. v+113. (Washington, D.C.: Government Printing Office.) 10 cents.

Instituto Geográfico, Catastral y de Estadística. Anuario del Observatorio Astronómico de Madrid para 1933. Pp. 368. (Madrid.) Transactions and Proceedings of the New Zealand Institute. Vol. 63, Part 1, October. Pp. xli+79. (Dunedin.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 15: Examination of a proposed Relationship between the Lea Test and the Single Thread Test Results. By V. Venkataraman and Dr. Nazir Ahmad. Pp. 11. (Bombay.) 8 annas.

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 1: Malayan Agricultural Statistics, 1931. By D. H. Grist. Pp. iv+43. (Kuala Lumpur.) 50 cents.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 67: Methods for the Identification of the Coloured Woods of the Genus Eucalyptus. By H. E. Dadsell and Maisie Burnell. (Division of Forest Products, Technical Paper No. 5.) Pp. 50+34 plates. Bulletin No. 69: An Investigation of the Taxonomic and Agricultural Characters of the Danthonia Group. By A. B. Cashmore. Pp. 22+1 plate. Pamphlet No. 33: Enzootic Hæmaturia (Hæmaturia Vesicalis) of Cattle in South Australia. By Dr. L. B. Bull, C. G. Dickinson and A. T. Dann. Pp. 24. (Melbourne: H. J. Green.)

Reports of the Newfoundland Fishery Research Commission. Vol. 1, No. 4: Annual Report, Year 1931. Pp. 110+6 plates. (St. John's.) 1 dollar.

Canada: Department of Mines: Mines Branch. Feldspar. By Hugh S. Spence. (No. 731.) Pp. vii+145+13 plates. (Ottawa: F. A. Acland.) 25 cents.

Proceedings of the Imperial Academy. Vol. 8, No. 8, October. Pp. xxi-xxiii+331-405. (Tokyo.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 15, No. 3. Pp. ii+169-197+plates 11-13. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Spisy vydávané přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 153: Měření gravitační konstanty točivými vázkami (Mesure de la constante de gravitation par la balance de torsion). By Josef Zahradníček. Pp. 30. Čís. 154: O dispersi v teorii Markovových řetězů (Sur la dispersion dans la théorie des chaînes de Markoff). By Jan Potocék. Pp. 28. Čís. 155: Cristobalit ze serpentinit ze západní Moravy (Cristobalit aus westmährischer Serpentin). By Jiří Novák. Pp. 10. Čís. 156: Sur une équation fonctionnelle de la théorie des probabilités. By B. Hostinský. Pp. 36. Čís. 157: Beryllnaté soli paraderivátů benzensulfonové kyseliny a jejich hydrolyza (Beryllium Salts of the Paraderivatives of the Benzenesulphonic Acid and their Hydrolysis). By V. Čupr and J. Širůček. Pp. 28. Čís. 158: Buzení Hertzových vln diodami (Emission des ondes Hertziennes par des diodes). By J. Saňánek. Pp. 20. (Brno: A. Píša.)

Sborník vysoké školy zemědělské v Brně (Bulletin de l'Institut National Agronomique, Brno). Čís. 25: Vliv úpravy krmné dávky na produkci mléka se zřetelem na kvalitativní vlastnosti živin krmiva (The Influence of the Adjusted Ration in relation to Qualities of Nutrients on Milk Production). By Dr. Jaroslav Herzog. Pp. 55. D.19: Pokus o prozkum periodické proměny lesního a lučního stanoviště (Essai des recherches du changement périodique de la station forestière et de celle des prairies). By Dr. Alois Zlatník and Dr. Ivan Zvorykin. Pp. 129+26 plates. (Brno: A. Píša.)

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