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International Economics and Social Reconstruction

THE narrow outlook which continues to characterize much of the controversy regarding sanctions, the refusal to face the implications of collective security, and the disposition to blame a mere organization such as the League of Nations for failures due to lack of courage and foresight on the part of statesmen in using the machinery ready to their hand, should dispel any optimism that we are beginning to grasp the essential principles upon which the future well-being of mankind must be constructed. We may well doubt that there is sufficient political sense and stability in Europe or Asia to make world recovery possible at all. To those who maintain that our whole civilization is slipping into disintegration and dissolution from which all our mastery of the material universe is impotent to preserve it, a satisfactory answer is not readily found.

Reasons such as these, and the way in which the continued difficulties experienced by our own and other Governments in handling international affairs betray lack of capacity for real leadership and foresight, may well lead to misgivings as to the future in spite of the undoubted fall in unemployment and increase in industrial employment and trade. How well-founded are such misgivings is indicated by the admirable survey of world economic and social conditions provided by Mr. Harold Butler, Director of the International Labour Office, in his Annual Report*. It is clear from this survey that no certain answer can yet be given to the question whether the past year should be regarded as marking the emergence of the world into the flowing tide of recovery or as merely an interlude of mitigated depression.

On the credit side of the economic balance sheet must be set a gradual improvement in prices and a continued decline in unemployment. In many countries, the general index of industrial production has moved steadily upwards; but in so far as this industrial prosperity is founded on the expansion of armaments, which notoriously is taking place in the principal industrial countries, it is hollow and unusual as well as sinister. The manufacture of arms adds nothing to national wealth, and the economic consequences of rearmament must be set in the scale against the apparent sign of economic revival. The universal alarm and anxiety which accompany intensive competition in armaments check the expansion of healthy trade and investment, and block the path of normal recovery.

The armament situation itself is thus reason enough for some misgivings about the present situation. The slight improvement in the volume of international trade, and the extent to which economic nationalism continues to hold the field, are other reasons for anxiety. Confidence in foreign investment is still lacking, and the major obstacle to the re-birth of confidence is the fear of war, imminent or not remote; and economic recovery is an impossible dream until this fear of another and more catastrophic collapse of the whole international political system has been dispelled.

Given a general will to seek that end in a constructive and co-operative spirit, the task is not yet impossible in spite of its increased difficulties; but it calls for the display of statesmanship of the highest order. It must be realized that the most radical flaw in the recent peace settlement was the failure to ensure economic and social equilibrium. Territorial claims and armament programmes are the symptoms—not the causes—of our present

* Report of the Director, International Labour Office, Geneva, 1936.

condition. The roots are to be found in actual or threatened impoverishment, declining standards of life, insecurity for the future of themselves and their children which darkens the outlook of the present generation in so many countries. The question of peace can no longer be discussed apart from that of social justice.

On such grounds as these, Mr. Butler is led to a point of view which many scientific workers have reached, from their survey of the possibilities of the applications of science being utilized to raise the general standards of and amenities of human life, and to assist in the distribution of the economic resources now at our disposal. No longer can we think of life in terms of sub-divisions only. Artificial barriers which hamper our thought about men in society must be broken down and a synthesis of all the social sciences achieved which will permit a true notion of the structure and possibilities of society, just as it is only by a synthesis of all the sciences concerned with man and his environment that we can understand his nature.

Mr. Butler's brief summary of the immediate problems of social reconstruction which call for consideration has points in common, such as housing, with those which in Great Britain are already receiving the attention of such groups as P.E.P. (Political and Economic Planning), or nutrition, on which scientific workers have done much to provide a basis for action. Mr. Butler refers to the way in which these questions are linked to those of international trade and finance. The question of raw materials is similarly linked and is not even mainly a colonial problem. The countries which have real difficulties in procuring their supply of raw materials are those which have imposed restrictions in dealings in foreign exchange, due to their monetary or commercial policies. The problem cannot be divorced from the whole question of restrictions on commerce, including the question of the 'open door' in colonial territories which are large providers of certain raw materials.

These problems in themselves raise broad questions of colonial policy, not only in regard to raw materials but also in regard to labour and migration. The need for investigating such problems is now becoming generally admitted, and they can only be dealt with on practical lines if account is taken not only of general principles, such as are embodied in the Mandates Article of the Covenant of the League of Nations, but also

of the conditions and requirements of each particular case. Not the least untoward consequence of Italian aggression in Abyssinia is the way in which it has enhanced the difficulties of an impartial and adequate treatment of questions which were already sufficiently thorny.

Last and most important of all in the programme of reconstruction is the problem of liberating commerce from the restrictions which have been imposed upon it by nationalist economic policies or on account of currency disorders. From whatever angle we approach the problem of reconstruction, the only path leading to its solution is that of closer international intercourse. The doctrines of nationalism and self-determination may within limits be beneficial and stimulating in the field of politics and culture, but in the field of economics they are fatal. Economic nationalism in its recently developing forms is incompatible with economic stability and therefore with the peace of the world.

The only way out of our troubles is, therefore, to restore so far as possible exchange of goods, services, money and population on which pre-War prosperity was founded, and which the rapid progress in means of communication has made all the more imperative. The new world economy to be built up, however, must take account of all the developments which have taken place since 1914. The great internal transformation in industry and agriculture cannot be set aside without causing still further confusion and upheaval. They necessitate a complete readjustment of method, but the ultimate objective is unchanged.

Mr. Butler gives us once more a survey which commends itself to the scientific worker alike for its presentation of the facts on a broad canvas free from the distortion of material or party bias as for its insistence on the necessity of viewing life as a whole. Economics cannot be separated from ethics, social justice from material well-being, or social and ethical aspirations from political activities. Peace itself is not possible without social justice between nations and between individuals, and only through an equitable organization of the world's economic life can peace and justice and freedom be made secure.

These views to-day are in danger of becoming platitudes, though they touch the quality and direction of scientific life and thought as of every other intellectual or physical activity. It is only as creative thought is brought patiently and impartially to bear on these questions that we can

hope to find the lines of a solution ; and the major question is whether sufficient moral and social pressure can be mobilized in support of constructive policies in which science plays its fitting part, before the reactionary forces of militarism and economic rivalry and autarchy bring the whole fabric of our civilization to collapse.

The root question behind this appeal for world co-operation is the choice between freedom and slavery of the spirit. Freedom of thought and speech, belief and investigation, subject only to

the recognition of the same liberty on the part of others, is exactly what is threatened by the new tyrannies which, through their militarism and economic nationalism run mad, seek often in subtle ways to reduce the citizen to a soulless unit, to moral and intellectual servitude. The perpetuation of economic antagonism and military rivalries is as grave a danger to scientific thought and investigation, upon which so many of its material achievements are based, as it is to the continuance of our material civilization.

Manifolds of Plenary Space

Intrinsic Geometry of Ideal Space

By Dr. A. R. Forsyth. Vol. 1 : pp. xxvi + 553. Vol. 2 : pp. xiv + 655. (London : Macmillan and Co., Ltd., 1935.) 2 Vols. £6 6s. 0d. net.

IT is desirable to give the reader immediately an idea of what is an ideal space and its intrinsic geometry. Prof. Forsyth writes : "The present work is occupied with investigations of those intrinsic properties and differential measures of geometrical amplitudes which are connected with the corporate characteristics and the organic constituents of the amplitudes". Hence we see, if we do not know what is an ideal space, we know at least that we can substitute the word "amplitude" for it ; and instead of "intrinsic" we can use "corporate" and "organic". That is all. We must seek an interpretation of these mysterious words going through the 1248 pages of this work. Before we can do that, we must become acquainted with some other words : plenary uncurved or homaloidal (Euclidean space) ; flat and block (Euclidean spaces of dimensions three and four) ; amplitude (manifold) ; regions and domains (manifolds of three and four dimensions) ; tilt and coil (third and fourth curvature) ; gremial, orbicular, and globular curvatures ; and other curiously used words.

Passing over Eleusinian statements like this : "The homaloidal space is free from all native measures that can modify the geometrical character of included figures : its standardising influence is impartially neutral", we begin to examine the contents.

Section I, after an introduction where we discover the identity between homaloidal and Euclidean space (How can that be ? Was it not free from any native measure ?) and where we find the old Frenet equations, gives a sketch of Riemannian

geometry (geodesics, Riemann's curvature), with a mixture of properties not belonging to this geometry but to the ordinary Euclidean geometry of the manifold (as embedded in a Euclidean space). Such are the researches on the locus of the centres of first curvatures of geodesics of a manifold V_n concurrent at a point : the cases when the dimensions of the plenary space (Euclidean space embedding the V_n) are $n+2$ or $n+3$ are discussed. In this second case two subcases arise ; but no hint is given of the projective ground on which this distinction stands. Neither is there any suggestion of what may happen when that space has more than $n+3$ dimensions, although the number of possibilities is finite.

With Section II begin the limitations of the field of research ; the author restricts his studies to surfaces (Section II), regions (Section III) and domains (Section IV) and to their subamplitudes. Here also we find properties of Riemannian character (geodesics, Riemannian curvature, Levi-Civita's parallelism, minimal surfaces and regions) scattered in different chapters, according to the dimensionality of the amplitude ; also, when they are independent of it, mixed up with properties relating the amplitude to its Euclidean space. There is a wealth of particular results (new or not, that is difficult to state from quotations in the book), but no general idea. It is a kind of empirical 'going on', step after step, with apparently no goal to be reached. The method of attack has also the same empirical character : it would certainly be inadequate for a research of broader frame.

Now some selected topics. Section I contains some theorems which can be summarized as follows : the second, third and fourth normal of a geodesic of an amplitude (at a point) lie in the tangent homaloid of the amplitude. This is a serious mistake, and no calculations are necessary

to check it. In fact, not only is the reasoning on which it is established evidently wrong, but, should it be true, it would lead to the amusing conclusion that the geodesics of any surface whatever belong to spaces of three dimensions! This mistake is of no little moment: it invalidates many results in different sections of the book.

Section II opens with the following question: Is it possible to find a lower limit to the dimensionality of the Euclidean space (plenary homaloid) containing a surface with a given arc-element? The answer, given by Darboux in 1872, and referred to in all standard treatises on the subject (like Darboux's and Bianchi's) is in the affirmative. It is always possible to construct such a surface in a space of three dimensions by integrating a Monge-Ampère equation and by quadratures. Prof. Forsyth's answer is in the negative*: it is true that he speaks of an upper limit, but what he means (as can be seen from the discussion) is a lower limit. This is all the more reason that a search for an upper limit has no value, it being evident that, given a surface in a 3-space, surfaces with the same arc-element can be found in a space with greater number of dimensions. Prof. Forsyth seems struck by the example he gives of a surface in a space with an infinite number of dimensions: there is nothing surprising in it, the dimensionality of the space having nothing to do with the arc-element of the surface (it is not a Riemannian character).

Another topic to be mentioned—and this will be the last one—is the statement, often repeated and invalidating many results, that when a certain determinant vanishes (see, for example, vol. 1, p. 369) or, what is the same thing, when the first and second derivatives of the co-ordinates of a point of a surface are not linearly independent,

*The correct result is given in a corrigenda sheet which has been issued since publication of the book.

the surface lies in a quadruple homaloid. To make the mistake more curious, the example given before of a surface belonging to a space with infinite dimensions contradicts the last statement. But this is only one example, and the simplest one, of the contradictions which arise when the projective characters of the manifold are not considered. I have emphasized many times the fact that, when studying the differential properties of a given order (of differentiation), the basic element to be considered is not the dimensionality of the space in which the manifold is immersed (which may also be infinite, with no danger) but the dimensionality of certain osculating spaces (as I call them) projectively connected with the manifold.

The author describes his book as an adventure into the realm of investigating manifolds (not curves or hypersurfaces) existing in a plenary space. Thirty years ago, E. E. Levi (who is not quoted in this work) entered the same realm, harvesting the first results (for two-dimensional surfaces) and showing its difficulties. More than twenty years ago, I tackled the problem again, and conceived the idea of Riemannian geometries of higher species ("Geometrie Riemanniane di specie superiore". *Mem. R. Accad. d'Italia*, 1935), showing that the differential properties of a given order r of a manifold (whatever its embedding space may be) can be described in terms of r differential forms of the first order and of $2, 4, \dots, 2r$ degree. But the step was not easy. To fill the gap it was necessary to build up the projective differential geometry of manifolds, or more exactly of linear partial differential equations. In the meantime, other investigators have taken part in the work, as Vitali, Enea Bortolotti, Burstin, Duschek and Meyer; apparently passing over all this work, Prof. Forsyth has followed his own way.

E. BOMPIANI.

Sea Urchins

A Monograph of the Echinoidea
2: Bothriocidaroida, Melonechinoida, Lepidocentroida and Stirodonta. By Th. Mortensen. Text. Pp. vi+647. Atlas. Pp. ii+16+89 plates. (Copenhagen: C. A. Reitzel; London: Oxford University Press, 1935.) 2 vols., 140s. net.

THIS monograph attracts a review, for it exhibits features of a distinctly novel nature and it approaches perfection as near as can be. The animals are the box-like sea-urchins, starfishes with radiating segments and brick-like walls (tests)

decorated with spines and fine sculpturing. They walk by outpushings of fine tubes (tube-feet) with terminal sucking-disks arranged in five rays, such as cause starfish to be of unique personality. They belong to Mortensen more than to anyone else, for he has pursued the living forms in most parts of the world. Here, his study of the urchins' habits, food and ecology was antecedent to that of their classification, and he thus by analogy can tell us much of the life of the extinct forms. Of the latter there is a long series from the Palaeozoic, and it would seem

probable that these animals have never been less numerous either in genera and species or in individuals than they are to-day. Thus the relatively deep-living Salenidæ had eighty-five species in the Cretaceous as compared with only twelve species to-day, but all the extinct forms were not deep-living.

The first animal here considered, *Bothriocidaris*, was formerly regarded as the ancestor of all sea-urchins, but more ancient forms are now known, and Mortensen evidently places it here to avoid making another phylum. He supposes that it must have ingested food through the mouth, probably the adoral spines and tube-feet helping as in the living spatangoids. Judging by the deposits where it occurs, it lived in shallow reef-pools, which, according to the indications furnished by its test, cannot have been exposed to strong wave-action. It is this thought of the fossil forms as once alive and playing their parts on the ocean floor which makes this monograph so illuminating, its animals far more than mere dates in a strati-

graphical series and its living forms the few survivors of a long ancestry.

Only three divisions (Melonechinoida, Lepidocentroida and Stirodonta), besides Bothriocidaroida with its single genus, are monographed. They contain 22 recent and 116 fossil genera. All the genera are described, while in addition the 84 existing species are fully considered in respect to their anatomy, colour, occurrence and, so far as possible, their ecology; the text illustrations of the anatomy form a feature of great utility. The same technique is applied to the fossil genera, the anatomy of which is illustrated while their affinities are considered. Many of the species are referred to, but it is beyond the author's scope to consider all the described fossil forms. Added to the monograph is a volume of plates of high quality.

The whole is of great credit not only to Mortensen but also to Denmark and to the managers of the Carlsberg Fund, whose financial aid alone made possible the printing of this luxurious publication, which it is a joy to handle.

J. S. G.

Negroes and Pygmies

My Pygmy and Negro Hosts

By Paul Schebesta. Translated from the German by Gerald Griffin. Pp. 287+31 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 18s. net.

FATHER PAUL SCHEBESTA, whose intimate knowledge of the pygmy problem, acquired in the Far East as well as in Africa, transcends that of any living ethnologist, has now produced a sequel to "Among Congo Pigmies". In this he supplements his earlier work on the Congo pygmies by an account of the Batwa of Ruanda and the Bachwa of the Equatorial Province, who, if not all pygmies, at least merit the title of half-pygmies. More important, however, for his present purpose, are the tribes of full stature with whom he came into contact on his travels in 1929 and the two succeeding years.

Interesting for the ethnologist as must be the comparison of the material relating to the pygmy peoples given here with that of the previous book, it will probably appear to most readers that the author has displayed sound judgment in devoting the larger share of his attention to the tribes other than pygmy. For one thing, this material is essential for an understanding of the ethnological background, in view of the close relation, almost a symbiosis, between the pygmy and his taller

neighbour, while in the second place, the culture of these peoples is both intrinsically interesting, and for the most part has not previously been described. Witchcraft, cannibalism and tribal history afford the author a rich field for description. It may be hoped that material for a fuller and more systematic analysis of the last named will be forthcoming later. Some further details, too, of the evidence upon which is based the suggestion of a surviving influence from Ancient Egypt will be welcomed.

The author was much impressed by his visit to the Royal Court of the intrusive Batutsi of the mandated territory of Ruanda, in which, as he points out, there are certain close resemblances to the court of Uganda. He was admitted to the presence of the Royal Mother—a privilege formerly denied to the foreigner, and evidently resented. Shortly after, the dynasty was deposed by the Belgian authorities.

The narrative offers innumerable tempting paths which would lead to discussion, such as, for example, the association of initiation ceremonial with a cannibalistic 'leopard' society among the Babali, where also initiation takes the place of circumcision, universal among the other tribes. The author himself was responsible for the discovery of a secret 'leopard men' society and its association with cannibalism among the Babali.

At the present moment, when African colonies and mandated territories are much under discussion, Father Schebesta's final chapter, in which he deals with the relations of black and white in the Congo, will be found to contain much that is pertinent. Belgium, he points out, is intensely proud of the possession of the Congo and has made immense sacrifices for its benefit. Since the Great War, a complete change has taken place in the spirit of the administration, and every effort has been directed towards the benefit of the natives. In the main these efforts have taken two directions—the building of roads and the formation of an administrative organization for the government of the natives in accordance with their own cultural ideas. As the author points out, the making of roads has conferred no benefit on the natives,

while imposing on them a heavy burden of upkeep; and the system of headmen or *chefs de section* has been applied without discrimination. In certain instances it was applied to peoples to whom it was not adapted; in others the headman, as happened also at times in British mandated territory, was merely a figure-head, because the real native rulers, the spiritual chiefs, remained in the background and continued to receive the peoples' allegiance. Apart from the author's criticisms, there is evidence here and there in his narrative that the administrative system lacks the necessary basis of a scientific study of native institutions, which has been recognized elsewhere as a necessary preliminary, however superficial it may have been in practice, owing to lack of time or other impeding conditions.

New Ornamental Trees and Shrubs

Trees and Shrubs hardy in the British Isles

By W. J. Bean. Vol. 3. Pp. xiv+517+64 plates. (London: John Murray, 1933.) 36s. net.

DURING the planting season, those of us who wish to make our gardens more attractive by the addition of flowering shrubs or trees, scanned nurserymen's catalogues for some of the more showy and less commonly seen species, so many of which have been introduced in recent years. The wanderings of Forrest, Kingdon Ward, Wilson, Farrer, Comber and Rock have greatly increased the possibilities for variety. Now that the new introductions have been tested as to adaptability to our climate, at Kew, Edinburgh, Wisley and elsewhere, seeds and plants of those which have proved satisfactory are becoming available for distribution, at a moderate price, to gardens with only limited space.

Those who are looking for new and interesting species would be well advised to study carefully the third volume of Bean's "Trees and Shrubs hardy in the British Isles". This is a supplementary volume to the first two, which were issued in 1914; it has been written with the same care and precision, and that unrivalled personal knowledge of the plants themselves and their requirements, which are so characteristic of all Mr. Bean's work. It comprises 517 pages and includes 64 full-page illustrations from photographs by such well-known lovers of trees as Lieut.-Colonel Stephenson-Clarke, Dr. Wilfred Fox and the late Dr. E. H. Wilson, and others by R. A. Malby and Co. These, in themselves, are a joy

to look at; where all are beautiful and well-selected, it is almost invidious to mention any in particular, but perhaps *Magnolia sinensis*; *Pyrus* (*Sorbus*) *munda* var. *subarachnoidea* with its white fruits showing beautifully against a dark background; *Halesia monticola* with its bell-shaped flowers; and the charming habit photograph of *Cercidiphyllum japonicum* at Westonbirt, are worth especial mention.

Magnolia sinensis Stapf, from West Szechuen, China, where it occurs at 7,500–9,000 ft. altitude, is said to be perfectly hardy, forming a pleasant addition to the list of magnolias. It is described as a deciduous shrub or small tree, bearing saucer-shaped, fragrant white flowers 3–4 inches across, having rosy-crimson stamens; a useful feature is said to be its ability to thrive in a chalky soil. *Meliosma beaniana* Rehder and Wilson, from Hupeh and Szechuen, is said to grow "healthily" at Kew. Wilson described it as one of the most striking and handsome of Chinese trees, with leaves 6–12 inches long, and creamy-white panicles up to 8 inches long and 4 inches wide.

Of *Cornus kousa* var. *chinensis* Osborn, Mr. Bean says that this beautiful flowering tree should be in every garden, being perfectly hardy and blossoming at a season when most hardy trees and shrubs are out of flower. It is encouraging to read of a *Paulownia* (*P. fargesii* Franchet) which seems to be hardier at Kew than is *P. imperialis*.

Ceanothus cyaneus Eastwood, is described by Miss Eastwood, the veteran curator of the California Academy of Sciences herbarium, in Golden

Gate Park, San Francisco; as "certainly the loveliest of all the species of *Ceanothus*, with its large sprays" of flowers of a lovely bright blue, each about $\frac{1}{4}$ in. across. It is grown at Kew on a wall facing east, but suffered from frost in the spring of 1932, and Mr. Bean thinks it will probably be seen at its best nearer the south coast.

Of other genera represented in gardens by well-known species, many novelties are described, including 29 of *Berberis*, of which 3 are figured; *Betula* 7; *Buddleia* 11, *Ceanothus* 7, *Pyrus* 26, *Prunus* 16 and *Pittosporum* 11.

Of the New Zealand genus *Olearia* (daisy bush), of which the hardy *O. haastii* is the best known, twenty-four species are described, most of which, unfortunately, are hardy only in the mildest parts of Britain.

The genus *Rhododendron* comes in, of course, for the greatest attention, the account of it occupying 91 pages (out of the total 517), 173 species or hybrids being described and 14 figured.

The value of the book is indicated by the fact that a second edition has just been published.

Mathematics and Agriculture

Mathematical Treatment of the Results of Agricultural and other Experiments

By Prof. Dr. M. J. Van Uven. Pp. vi+310. (Groningen and Batavia: P. Noordhoff, N.V., 1935.) 9.50 f.

WE have become accustomed in Great Britain, mainly through the writings of Prof. R. A. Fisher, to the idea that accurate field experimentation in agriculture and cognate sciences is only possible through bringing certain principles of experimental design, mainly mathematical in character, to bear on the problem before the experiment is carried out, and then building up an arithmetical technique, based on the theory of statistics, for the working out of the data resulting from the experiment.

Dr. M. J. Van Uven, who is professor of mathematics in the Agricultural University of Wageningen, Holland, has been associated for many years with agricultural experimentation, and in this book he is concerned to place before readers a careful exposition of the mathematical and technical methods which are needed. He is not writing for the worker who merely desires a formula for the working out of a mean or a standard error. On the other hand, he wishes to be understood by a reader with only a modest equipment of mathematical knowledge. The result is a book, the first half of which is a carefully written and particularly full treatise on least squares. No appeal is made to other than straightforward algebra, but even so the book is by no means easy reading. The general subject is the adjustment of observations, direct and indirect, in one or more variables, including the choice of the representative value, the calculation of mean error of single observations, and of functions of these, and an elementary exposition of probability.

In the second part the author takes up the study of field experiments, beginning by showing how yields of plots can be adjusted when there is a regular fertility distribution. When this condition is not satisfied, he shows how to separate out the systematic and accidental causes of variation by means of an analysis of the variance of the yields. He considers the case of two treatments on alternate plots, and describes his method of working out the standard error of the difference between the treatment means. He recognizes, however, that such an arrangement is far from ideal, and proposes instead that the original plots should be divided to accommodate the number of treatments it is desired to test. This makes the trial one of a larger number of plots of smaller dimensions, but the author does not say how the treatments should be arranged within the plot, whether at random or systematically.

A long description follows of Fisher's methods of block trials, including as a special case the Latin square. There is much to interest the reader here in the exposition of the algebra of the method, and its various ramifications, but the author does not point out that one of the essential features of the methods is the random arrangement. Indeed his examples are systematically arranged, although he does point out, in the case of the Latin square, that some re-arrangement would be advisable to prevent the same treatment occurring down the diagonal.

The author returns to least squares in the last chapter, dealing with the adjustment of direct conditioned observations, and four appendixes are added dealing in detail with points arising in the text. The last, indeed, gives the complete technique of solution for normal equations.

The book is well and attractively printed, and there are few misprints. J. WISHART.

The Atom

By Prof. E. N. da C. Andrade. New edition, entirely revised, extended and reset. Pp. ix+129. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1936.) 1s. 6d. net.

PROF. ANDRADE dedicates this little book to two friends as a memorial to "a lively, learned, and humane luncheon table", and thereby sets the tone of what follows. Starting with an account of the meaning of the atomic theory, he takes the reader smoothly along, with many a well-chosen analogy and an occasional jest, dealing with the atom of electricity, the nature of light, the structure of the atom, the mechanism of radiation and, in the concluding chapter, with the relation between matter and energy.

We read of the positron, neutron, wave mechanics, quantum theory of spectra, transmutation of atoms and artificial radioactivity, all in a descriptive narrative using everyday illustrations to make difficult conceptions clear. A large ship, with engines stopped, rolling and pitching on the open sea, reveals by its motion to an observer in an aeroplane that the sea is rough even though he cannot see the waves; so the Brownian movement in a liquid reveals the motion of its molecules. Cigarettes of various sizes are sold, but we have to buy a whole number; similarly, the quantum of radiant energy varies with frequency, but we never find less than one quantum, whatever the frequency. A given kind of atom may be regarded as singing two characteristic songs in the bass (flame and spark spectra) and one in the high soprano (X-ray spectrum).

Prof. Andrade's hope that he will arouse a desire to pursue the subject further will surely be fulfilled. We may commend the book also to senior physics pupils in schools, who will obtain from it a broad and often novel view of recent developments in their subject.

The Identification of Trees and Shrubs:

how to name without previous Knowledge of Botany any Wild or Garden Tree or Shrub likely to be met with in the British Isles. By F. K. Makins. Pp. vii+326. (London: J. M. Dent and Sons, Ltd., 1936.) 15s. net.

THE appearance of a book that aims at supplying the means of identification of trees and shrubs that occur in Britain—wild or cultivated out of doors—should meet with a wide appeal. It is true that the indigenous woody species, which number only a few dozen, may be readily named from existing floras and handbooks, and that there are excellent works describing the legion of trees and shrubs now in cultivation; nevertheless, so far, there has been no attempt to provide a general key or other ready means of identification of the cultivated species, and the present work is a pioneer in this respect.

The book is easy of reference and assumes no previous botanical knowledge. Only those species that the author considers most likely to be met with are considered, rare or little-known plants being purposely omitted. In spite of this limitation, the

number of woody plants dealt with is 1,732, or rather more than half those listed in the Kew "Handlist of Trees and Shrubs" (1934) which places the total number at about 3,000. Each species is represented by a small illustration or diagram, and is briefly described in the later part of the volume. A preliminary key on basic leaf characters serves to direct the user to the requisite group of diagrams to which any particular plant may belong.

The work should prove useful, particularly in naming the more generally cultivated trees and shrubs; but limitations of size must effect its usefulness in the case of the larger genera with numerous closely allied species, for example, *Rhododendron*, *Cotoneaster*, *Crataegus* and certain *Coniferae*.

Insect Pests of Glasshouse Crops

By Dr. Herbert W. Miles and Mary Miles. Edited by H. C. Long. Pp. 174+21 plates. (Surbiton: H. C. Long, The Birkins, Orchard Road, Hook, 1935.) 8s. 6d. net.

GLASS-HOUSE cultivation provides a type of environment which favours the spread and multiplication of a variety of insects and related creatures of injurious propensities. At the same time, these conditions afford facilities for pest control that are often exceptional. The growing extension of the glass-house industry has brought the cultivator up against the problem of pest elimination more realistically than in years gone by. New pests have come to light, species formerly regarded as innocuous have, after proper study, proved to be the reverse, and the list of known invaders has assumed considerable proportions.

Much valuable information is now available on the subject of glass-house pests, but it has mostly remained inaccessible to the amateur and to many professional growers. Dr. and Mrs. Miles have thus supplied a much-needed requirement in the book under notice. Their experience and qualifications have well fitted them for their task and they have produced a sound, up-to-date manual covering the whole range of pests likely to be met with. These are clearly described, along with their life-histories, and the most practical and efficacious methods of control. The book is well illustrated with a remarkably good series of clear photographs, almost all being hitherto unpublished. It can be recommended to all interested as one which is based upon practical experience and not merely compiled from the writings of others.

A. D. I.

Odyssey of the Islands

By Carl N. Taylor. Pp. xiv+284+31 plates. (New York and London: Charles Scribner's Sons, 1936.) 12s. 6d.

MR. TAYLOR describes himself as a 'vagabond', and entertaining as this record of a vagabond's wanderings may be, it does not call for extended notice here. It is, however, to be noted as giving a view of life among the wilder peoples of the Philippines, which includes an account of the too little known and often unapproachable pygmies. The book is illustrated by some excellent photographs.

The Total Solar Eclipse of June 19, 1936

Observations at Omsk

By Prof. J. A. Carroll, University of Aberdeen

THE expedition of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, and the University of Aberdeen, which was stationed at Omsk, had the good fortune to observe the total solar eclipse of June 19, 1936, under excellent conditions.

The expedition consisted of five members, namely, Prof. J. A. Carroll, professor of natural philosophy in the University of Aberdeen (leader); Mr. E. G. Williams, Solar Physics Observatory, Cambridge; Miss F. M. MacBain, Natural Philosophy Department, Aberdeen; and two volunteer observers, Mr. W. M. Alexander, Aberdeen; and Capt. S. I. Luck, London.

Our programme contained only three principal items, but as the instruments, methods and auxiliary equipment were in many respects quite novel, some detail of description will be of interest to readers of NATURE.

To deal first with the observing instruments themselves, and the results yielded by them:

(1) A very rapid objective prism spectrograph specially intended for exploratory work in the infra-red region of the coronal spectrum, but, of course, also used on the flash spectrum. Five 60° prisms were followed by an objective of two inches aperture and twenty inches focal length, giving a dispersion of about 100 A. per mm. at 9000 A., and covering the range from the *D*-lines of sodium to about 11,000 A. on several pieces of plate of different types. The plates used were (1) Ilford S.R. Panchromatic, (2) Agfa 800 Contrasty, (3) Agfa 950.

We were particularly concerned to detect the coronal radiation at about 9600 A. predicted by Rosenthal¹ on the supposition that the major coronal lines are due to excited helium atoms, and also to observe the line at 7896 A. observed by Curtis and Burns² in 1925 and recently observed by Lyot³ at the Pic du Midi without eclipse.

Plates sensitive so far in the infra-red have in general poor keeping qualities, and the plates used were sent by air and by special messenger from

Berlin as shortly before the eclipse as possible. We are much indebted to Messrs. Agfa for the prompt supply of fresh plates and to the British Embassy in Moscow and the Poulkovo Observatory for their rapid transit to Omsk, where we could keep them on ice. Thus our plates were in good condition, and thanks to the thermostatic control the instrument performed well.

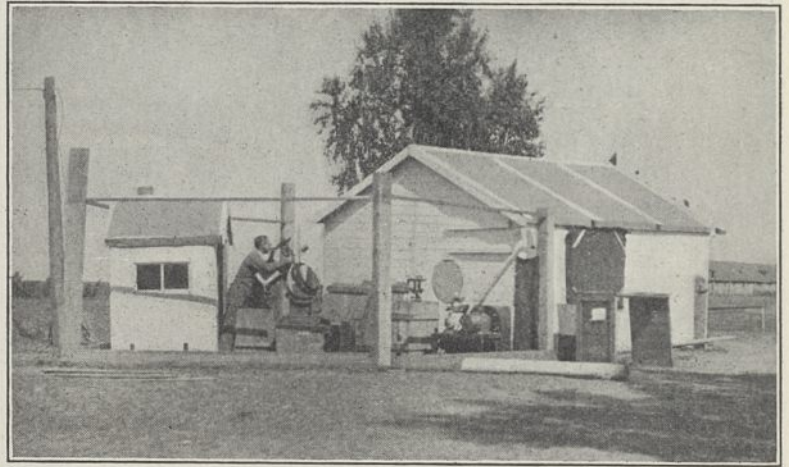


FIG. 1. Exterior of the celostat and experimental hut, looking east. The double-walled hut on wheels for sheltering the celostat is on the left. The larger hut is the double-walled, felt-lined hut for thermostatic sheltering of the instruments. At the nearest corner of the large hut can be seen the compressor for the refrigerator plant, and just above it the circular window to admit the horizontal beam from the celostat.

The plates show many flash lines and a number of coronal rings. Four exposures were given, (1) 5 sec. on the first flash, (2) 20 sec. on the corona, (3) 90 sec. on the corona, (4) 7 sec. on the second flash. Timing was good, and both flashes are satisfactory. In the flash spectrum, the Ca II triplet at 8500 A. is strong, the usual features show in the visible region and there are several strong lines in the region 9000 A.–10,000 A. not yet certainly identified, probably including a line due to helium. On the coronal exposures 6374 A. is strong and also the line near 7890 A. There is no strong radiation in the expected region near 9600 A., though later examination may reveal traces. The plates were good enough to show strong lines down to 10,000 A. It is interesting to note that at mid-totality prominences show, in *H α* and the *D*-lines, on both sides of the solar disk.

(2) An objective interferometer of 13 cm. aperture and 105 cm. focal length for the study

of the corona in its own monochromatic green radiation at 5303 Å. The aim of this instrument is not, as some seem to have thought, to obtain accurate wave-lengths of the coronal green line. As this line is about 1 Å wide, the use of an interferometer for such a purpose is futile. The point is that by introducing a Fabry-Perot étalon into the optical train of a suitable objective spectrograph, one obtains a spectrograph working in all directions simultaneously as it were, and can obtain at all points of the corona the sort of information given by a powerful prism instrument, with a slit, over a small region only. Thus the variation in wave-length, strength, profile, and

The objective was a triplet of 6-inches aperture specially computed and made by Messrs. Adam Hilger, Ltd. The instrument worked excellently, and comparison fringes obtained during eclipse show exquisite definition at the full aperture.

Most unhappily, the light from the sun was cut off from this instrument during the total phase by a trivial accident, and only the comparison fringes remain to show the excellence of its performance. These are, however, not without interest in view of the remarks later on the need for, and benefits of, thermostatic control of eclipse instruments.

(3) An echelon spectrograph with automatic camera giving successive exposures of about 1.5 seconds for the study of the flash spectrum. It is of great interest to obtain accurate measures of the shapes of the chromospheric emission lines and of the changes in their shapes with height in the chromosphere. As these lines are only some 0.5 Å or so in width, very high resolution and dispersion are needed. An echelon spectroscope, crossed by, say, a pair of prisms, is almost the only instrument satisfying the necessary conditions for this type of observation, but so delicate an instrument is hard to use under eclipse conditions, and further, no echelons of large aperture exist.

The Natural Philosophy Department at Aberdeen possesses a very fine transmission echelon of 33 plates, each 1 cm. thick, height of step 1.1 mm., width

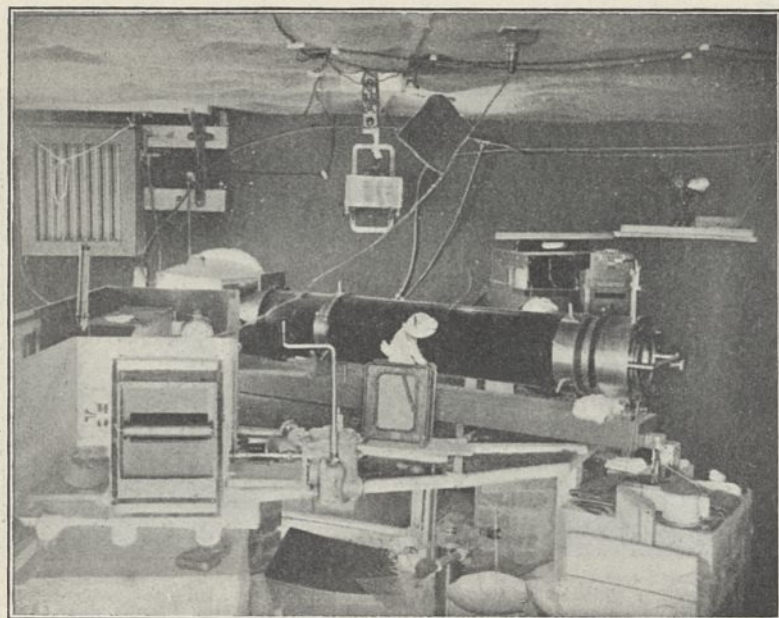


FIG. 2. Interior of experimental hut, showing echelon spectrograph, interferometer and infra-red objective prism spectrograph, with roof and sides of inner thermostatic chamber removed. One of the cooling coils of the refrigerator plant can be seen just above and to the left of the window admitting light from the cœlostat. In the opposite corner is one of the fans of the heating elements. In the centre of the ceiling are two thermostats controlling the cooling and heating elements for hut temperature. In the foreground is the heater element (surmounted by the Expedition's mascot) for fine control of instrument temperatures.

width of the line selected may be observed, and rotation and internal motion of the coronal material measured.

Two 6-inch 45° prisms dispersed the continuous spectrum sufficiently to allow the green ring to show by contrast, and the Ilford Astra VI plates were used, as these have a narrow maximum of sensitivity at 5300 Å. with good resolving power and contrast. The plates of the étalon were separated by 1 mm. and were coated with aluminium *in vacuo* in an apparatus specially constructed in the Natural Philosophy Department at Aberdeen, so that the coating was uniform to a fraction of one per cent and the density could be exactly controlled. Thus the greatest resolving power obtainable for the loss of light allowance was secured.

37 mm. This is still a very small aperture, but in view of the great interest of the observations and the great expense of a larger echelon, it was decided to attempt the observation of the flash spectrum with this instrument despite its small aperture. The information obtained would in any event be of vital importance in showing the practicability of the method and the size of instrument needed for accurate measurements, even if the flash spectrum turned out to be under-exposed.

As ordinarily used in air, the instrument had too small a separation between successive orders for use on the chromospheric lines, and the expedient of using the echelon immersed in oil of suitable refractive index was tried. Fortunately, the plates of the echelon turned out to be sufficiently homogeneous to permit this, and the main

difficulty was due to the now abnormal sensitivity of the instrument to temperature changes. Liquids all have a temperature coefficient of refractive index some ten or more times that of glass, and to maintain homogeneity to a small fraction of a wave-length in a column of liquid 40 cm. long by some 8 cm. square proved a formidable task. Success was ultimately attained by careful thermostatic control, combined with the use of concentric thick-walled chambers of good conducting material (brass or copper) separated by air spaces or lagging, so that the echelon and its oil were surrounded by three such 'tunnels', and uniformity of temperature was satisfactorily obtained. The optical and mechanical details of the instrument are far too elaborate to describe in a short article. In essence, the appropriate portion of the chromospheric arc is picked out by a specially designed image rotator and achromatic collimator, and the light dispersed horizontally by two flint prisms and vertically by the echelon. The resulting spectrum is received on a film in a camera automatically operated to expose for about 1.5 sec., then move the film forward in about 0.2 sec. and expose again as often as desired.

The spectra obtained at eclipse proved too faint for useful measurement of flash lines, but the spectrum of the disappearing limb of the sun is well exposed for a study of darkening towards the limb in the last minute of arc over the region 4000–5000 Å. It is of interest to note that the Fraunhofer lines seem to have almost completely disappeared by 10 seconds before second contact. The results given by this instrument suggest several possible avenues for exploration at future eclipses, and give accurate data enabling the design of a larger instrument to be undertaken with confidence in its adequacy and practicability.

Perhaps the most interesting and striking feature of our programme was the temperature control of the apparatus.

Modern eclipse observing requires the utmost of the optical performance of the instruments, and it is quite idle to set up spectrographs of any size with prisms and lenses, etc., figured to the last fraction of a wave-length, and expect any but mediocre results if they are subject to the ambient diurnal temperature changes. Still more is this so if interferometric apparatus is used. In Omsk the diurnal range of temperature was some 11° C., and this fluctuation was about a mean temperature that varied every few days from about 10° C. to 25° C. Ordinary lagging and screening by temporary shelters is hopelessly inadequate to deal with this, and it was decided to attempt complete and accurate temperature control as practised in the laboratory.

For this purpose the cœlostast mirror was of pyrex glass, and instead of the usual temporary canvas shelter a well-ventilated double-walled wooden hut, on wheels, was used to prevent undue fluctuation of mirror temperature. The performance of the mirror showed these precautions to be adequate so far as the cœlostast mirror is concerned, though a fused quartz mirror would be worth while. As the cœlostast must necessarily be uncovered in use, more accurate thermostatic control of it is impracticable.

The spectrographs themselves were very elaborately housed and controlled. Steady thermal conditions were obtained in two stages. First of all, a coarse control of the interior of the experi-

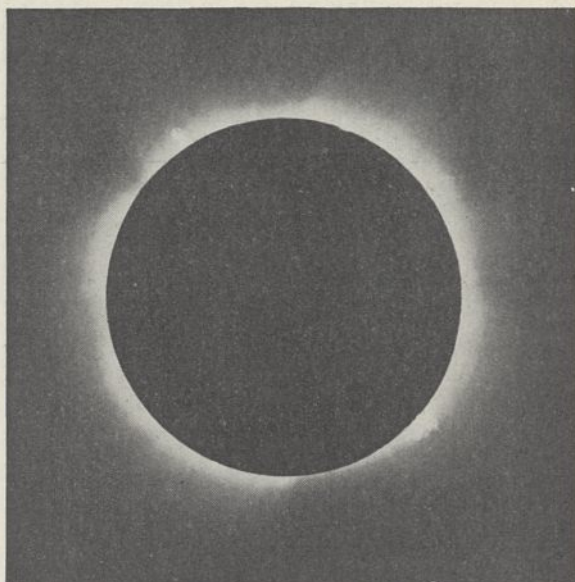


FIG. 3. Photograph of the corona taken by Mrs. Balanovsky, of Poulkovo Observatory, at Omsk. Lens, 5 m. focus; 10 cm. aperture; exposure, 1 sec. on Ilford Special Lantern Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

mental hut. This hut was of wood, double-walled and felt-lined, with canvas screens (kindly supplied by the Willesden Paper & Canvas Works, Ltd.) for roof and walls. The mean temperature inside was maintained at about $15^{\circ} \pm 1^{\circ}$ C. by means of a $1\frac{1}{2}$ h.p. compressor and refrigerating coils (air conditioning units) lent by International Refrigerators, Ltd., and also by two 1 kw. low-temperature heating frames interlocked with the refrigeration control and regulated by a thermionic relay. Within the hut the instruments themselves, supported on masonry piers, were further enclosed in a lagged wooden chamber maintained at 1° C. ± 0.01 above mean hut temperature by thermostat and thermionic relay operating a low-temperature heater only. Tests of heat transfer in Aberdeen showed this system to be practicable and able to deal with the variation of external conditions expected in Omsk.

It is very gratifying to be able to report that the installation, despite its elaboration, worked excellently. Some sixteen separately wired and fused circuits drawing currents of from $\frac{1}{2}$ ampere to 20 amperes were needed and were required to operate smoothly for a fortnight or more before the eclipse! Some troubles avoidable on a future occasion were experienced, but nothing disastrous, and the vagaries of electrical supply usual in remote districts were nobly reduced by the Omsk Electrical Supply Authorities despite our being some 8 km. from the generating station, on a line supplying heavy loads *en route*. Without the willing co-operation and special provisions of the supply authorities our efforts would have been

correct temperature of stabilization for the instruments. Any desired temperature could be maintained, but clearly the desideratum is to have the instruments as near as possible to the actual temperature of the outside air at mid-totally. The expected temperature, based on mean diurnal records and calculations of temperature drop during the partial phase, was 15.5°C . The eclipse day itself was cooler than average, and the actual temperature was only 13.5°C . at mid-totally. The light was admitted to the instruments through a hole in one end of the hut, and a corresponding hole in the interior casing. These apertures were fully opened some five minutes before second contact and all temperature controls disconnected, the aperture into the hut being opened and the coarse controls suspended some 15 minutes earlier. The definition during totality proved excellent and the trouble feared from air currents did not arise.

The general 'seeing' was very good, and as the down-coming beam from the sun had to pass over the roof of the hut, this was covered for the greater part of the partial phase by a Willesden canvas sheet, removed shortly before totality and leaving the roof itself in good temperature equality with the surrounding air.

It is with great pleasure and gratitude that we can say in conclusion that no praise is too high for the arrangements made for us and facilities given for ourselves and our apparatus. On all sides we met with cordial co-operation, and a willingness to cut through routine procedure to expedite or to simplify our task. The special committee appointed by the All Union Academy of Sciences made excellent arrangements, which were well carried out, and the Government of the U.S.S.R. granted us exceptionally favourable rates for transport and housing, so that it was possible to take out sufficient equipment and personnel to execute this elaborate programme in the middle of Siberia. To Dr. B. P. Gerasimovic, director of Poulkovo Observatory, in particular, we are especially indebted for his personal attention to the hundred and one points of detail, as well as for the major planning of the arrangements made for us in the U.S.S.R. By his courtesy, two excellent photographs (Figs. 3 and 4) of the corona obtained by the Poulkovo expeditions at Omsk and at Sara are reproduced here. The main Poulkovo station was near us at Omsk, on State Farm No. 54, and its observers and the staff of the State Farm rendered us much assistance for which we are deeply grateful.

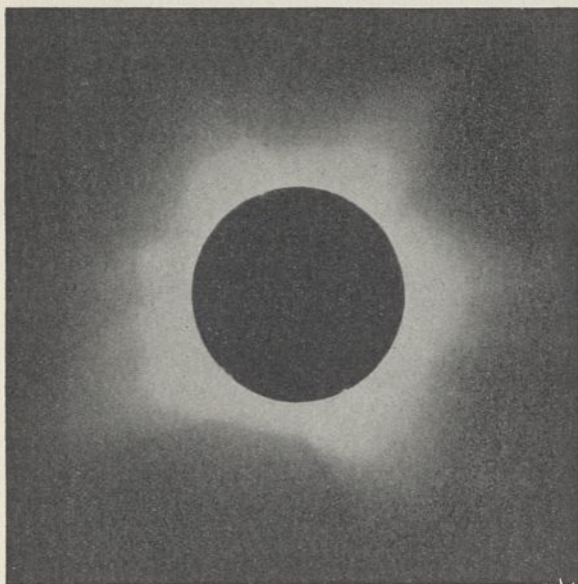


FIG. 4. Photograph of the corona in ultra-violet light taken by Dr. G. Tikoff, of Poulkovo Observatory, at Sara. Lens, 1.5 m. focus; 8 cm. aperture; exposure, 36 sec. on Ilford Special Rapid Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

nullified, and the way in which this unusual demand was met was typical of the treatment our Expedition received in the U.S.S.R.

It would have been idle to take such elaborate precautions to ensure perfection of optical performance if the photographic materials had not been equally carefully prepared, tested and selected. The resolving power of many suitable emulsions, as well as their sensitivity, was carefully measured in Aberdeen, and the equipment so designed that the optical resolution attainable could be fully utilized. We are much indebted to the Research Department of Messrs. Ilford, Ltd., for the willing preparation of special materials and samples for this work and to Mr. Olaf Bloch for much time spent in valuable discussion.

One point of anxiety that was difficult to relieve by tests made in advance was the question of the

¹ A. H. Rosenthal, *Z. Ast.*, 1, 115 (1930).

² Curtis and Burns, *Pub. Alleg. Obs.*, 6, 95.

³ B. Lyot, *C.R.*, 202, 1259 (1936). Lyot gives $7891.6 \pm 0.2\text{A}$. as a new line. The observations of Curtis and Burns in 1925 do not seem to be recorded in any of the more recent lists of coronal lines. I assume provisionally their line at 7896 is the same as Lyot's, allowing for the relative inaccuracies of the measurements made in 1925.

The Formosa Earthquake of April 21, 1935

WITHIN a year after its occurrence, the reports on this destructive earthquake have been issued in a special volume (Supplementary volume 3, 238 pages) of the *Bulletin of the Earthquake Research Institute*. The memoirs (eleven in number) are written in Japanese, each being followed by a summary in English. The five reports are also in Japanese, but only one of them contains an outline in a Western language. Few works on any earthquake have been so admirably illustrated, for half the volume consists of 29 maps and 119 plates, each of the latter containing reproductions of two or three photographs, with titles in English as well as in Japanese. They represent the damage to villages and buildings, the buckling of railway lines, the fissures in roads and fields, and various aspects of the remarkable earthquake faults.

The recent seismic activity of the northern half of the island is described by Prof. N. Miyabe (pp. 1-9), who notes that, since the beginning of 1934, the frequency of minor shocks felt at Ari-san (near the centre of the island) showed a continual increase up to the time of the great earthquake at 7.2 a.m. on April 21 (April 20, 10.2 p.m., G.M.T.). From seismographic records, the epicentre was found to be in lat. $24^{\circ} 20' N.$, long. $120^{\circ} 38' E.$, and the depth of its focus about 10 km. below the land-surface. The earthquake was very destructive to life and property; 3,279 persons were killed and 54,792 houses destroyed. In seven villages in the Taityu district, more than 70 per cent of the houses were ruined, but, as several of the authors notice, this was mainly due to their poor construction, the walls being formed of *dokaku* or blocks of hardened clay and straw, and very much weaker than those of the wooden houses in Japan. Mr. R. Takahasi (pp. 120-140) notes that the greatest intensity of the earthquake was reached in two regions that coincide with the north and south branches of the earthquake faults.

According to Mr. Y. Otuka (pp. 22-74), there were two main faults along which displacement of the crust occurred. The northern or Siko fault is about 15 km. long and runs in a direction about $N. 30^{\circ} E.$ from Gabi-syô to Taitôsei. Along this fault, the west side rose in two places about 3 metres relatively to the other side, the horizontal displacement being quite insignificant. The southern or Tonsikyaku fault is about 12 km. long and its general trend about $N. 60^{\circ} E.$ The north-west side of this fault was, relatively to the other

side, shifted $1-1\frac{1}{2}$ metres to the north east. Shortly before the earthquake, a fault was traced running from Gabi-syô to Taian, and the earthquake faults lie close to and parallel to this line. Mr. Otuka records the interesting fact that, at two places, the fault-movement took place after the houses in which the observers lived were destroyed.

From August until December 1935, the after-shocks were recorded at a network of four stations at which Ishimoto acceleration seismographs were installed. Most of the epicentres, according to Mr. N. Nasu (pp. 75-86), lay on the west side of the faults, and the focal depths were usually about 10 km. or less. In many of the shallow-focus earthquakes (depth 0-5 km.), the epicentres were close to the fault, especially in the upheaved region on its west side. Mr. Nasu notices that this was also the case with the after-shocks of the Tango earthquake of 1927 that he studied with so much care. At Byôritu (Taiwan), where the after-shocks were frequent, the level of the water in a well was measured from October 1935 (N. Miyabe and S. Kawasima, pp. 93-95). On the curve representing the changes of level from October 30 until January 10, dots are placed corresponding to the times of the after-shocks, and these occur at every point at which the level varies in direction.

The buckling of railway lines during a great earthquake is due, as a rule, to subsidence of the ground or to the destruction of the embankments on which the rails are laid. Such buckling occurs in both horizontal and vertical directions. Mr. R. Takahasi (pp. 148-153) describes and illustrates several cases of sinuous buckling. These are confined to a horizontal plane and lie along the fault-zone or its continuation. The buckling thus seems to be due to the movement of the surface layer of the ground on one or both sides of the fault.

Immediately after the earthquake, repetitions of first order triangulation and first order levelling were carried out in the central area by the Japanese Land Survey. The former, begun in August and finished in December 1935, included 14 points, three of which by comparison with the previous survey in 1917 had shifted by 26, 33 and 44 cm. The levelling was repeated along a route, 270 km. in length, from Kiirun and Musya, and was begun in October 1935 and completed in the following March. In the interval since the preceding survey, it appears that one point rose 23 cm., while another subsided 68 cm.

C. D.

Obituary

Sir Arnold Theiler, K.C.M.G.

THE death of Sir Arnold Theiler on July 24 at the age of sixty-nine years has removed from our midst one of the greatest and most practical exponents of veterinary science of the century. There was no man more cosmopolitan in his principles, nor indeed was there a veterinary surgeon who was more universally welcomed in every country within whose borders he set foot, than Sir Arnold. His modest demeanour and his forceful personality, together with his untiring patience and plodding disposition, made him welcome everywhere. A Swiss by nationality and a veterinary graduate of the University of Berne, Great Britain was lucky in having him as a worker within its Colonial domains; and it was a great day for the British veterinary profession when Sir Arnold was offered—and accepted—the honorary associateship of the Royal College of Veterinary Surgeons. It was also a great honour for the Royal Veterinary College in London, when Sir Arnold made the request to Sir Frederick Hobday, its principal, that he might complete, within its walls, the summary of the great work which he had collected together on the osteo-dystrophic diseases of bone. This shortly followed his lectures (which were also given in the Royal Veterinary College, at the request of the University of London), and it was another fortunate circumstance that the editor of the *English Veterinary Journal* was able to secure the publication of these lectures in his journal.

Born in Switzerland in 1867, Theiler went to the Transvaal as a doctor of veterinary medicine in 1891. He found the Boer farmers very difficult; their narrow ideas, which led them to think that the diseases of their cattle and sheep were punishment inflicted upon them by the Almighty, were very difficult to overcome. It was only when a severe outbreak of glanders among the horses in Pretoria, and a disastrous outbreak of rinderpest in their cattle, enabled him to demonstrate the value of scientific veterinary knowledge in checking these respective outbreaks, that his consummate patience and skill triumphed to the extent that President Kruger, realizing the great value of Theiler's help, appointed him Veterinary Surgeon to the Republic. The South African War temporarily checked his work, and, as a burgher, Theiler was appointed veterinary surgeon to the Stäats Artillery, a position which he filled with credit to himself—all the time with his brain working and learning points which stood him in good stead afterwards in his combat against disease.

Returning to Pretoria after the War, Theiler's reputation made him *persona grata* with the British Army staff, who were quick to recognize his knowledge and ability; and he was given laboratory facilities at Dasspoort and provided with an adequate staff. Whilst there, he came in contact with Lord

Milner and Mr. F. B. Smith, the Director of Agriculture; and eventually he was given practically a free hand, the result being the foundation of the greatest experimental veterinary laboratory in the world—at Onderstepoort. The Botha and Smuts Government gave him staunch support and, on the formation of the Union in 1910, Arnold Theiler became the first Director of Veterinary Research. In 1920 he organized the Veterinary Faculty of the University of South Africa, being appointed its first dean, a post which he held until his retirement in 1927.

Theiler's honours were many. In 1907 he had been created a C.M.G., and in 1914 the knighthood of this order became his; then the fellowship of the Royal Society of South Africa and the first grant and medal awarded by the South African Association for the Advancement of Science. He was also the first recipient of the Scott Medal of the South African Biological Society. He was an honorary D.Sc. of the Universities of Cape Town and Syracuse, and D.Phil. of the University of Berne.

Theiler's married life—always very simple—was a happy one, and he leaves behind a widow, two sons and two daughters, all of whom are making names for themselves in the world of science. His death has left a gap which it will be very difficult to fill; but his name will ever remain not only as a pioneer, but also as a creator, in the world of veterinary science.

Dr. Bernard Smith, F.R.S.

BRITISH geology in general and the Geological Survey of Great Britain in particular have suffered a lamentable loss through the death on August 19 of Dr. Bernard Smith. Since October of last year he had served as director of the Geological Survey and Museum in succession to Sir John Flett. Smith was not only a brilliant geologist but also a scientific worker of exceptionally wide outlook, and, as he had served for thirty years on the Geological Survey in varied districts and capacities, his knowledge of the geology of Great Britain was most accurate and extensive. He had a very lovable personality, being genial and sympathetic by nature, and his sound judgment carried him successfully through many difficult situations. He died at the comparatively early age of fifty-five years, while it might have been anticipated that he had at least ten years of active work to look forward to in the Government service. Up to a few weeks ago, he was in regular attendance at his office.

Smith was born in Grantham and had his preliminary education at King Edward VI School there. He passed to Sydney Sussex College, Cambridge, as a scholar, and graduated in the first class of the Natural Science Tripos, Parts I and II. He won the

Harkness Scholarship in 1906, having been a demonstrator in geology since 1904, and in 1906 also he entered the Geological Survey by competitive examination. For a time he worked in the Midland coalfields districts under Lamplugh, but he surveyed also in North Wales. When the Great War broke out he devoted much time to the study of British iron ores, on which subject he ultimately became a recognized authority; but he also gave much assistance to the Ministry of Munitions on many other subjects connected with British resources of economic minerals.

In 1920 Smith was appointed district geologist, and shortly thereafter proceeded to Whitehaven where he superintended the revision of the geological maps of the Cumberland coalfield and adjacent districts. He had already produced a notable monograph on the Cumberland hæmatite iron ores which soon passed into a second and revised edition, and is the standard work on that subject. The Cumberland coalfield is very complex in structure and was not well understood before the revision undertaken by Bernard Smith and his staff; but it may be said that it is now one of the best known British coalfields, and the new maps and memoirs leave nothing to be desired. His work in that district was much appreciated by the local engineers and mine owners, and his personal relations with all connected with the industry, even though they might differ from him in opinion, were always excellent.

In 1931 Dr. Smith succeeded Mr. John Allen Howe as assistant to the Director in London and was placed in charge of all the field work in England. He also arranged the North Wales exhibits in the new Museum of Practical Geology. His time was now principally occupied in administrative work, and in answering inquiries sent in by Government departments and by the public. In this respect he was a great success, and in due course he succeeded to the directorship of the Survey and Museum in October, 1935.

Smith's natural bent to field geology was shown by his text-book of "Physical Geography" (A. and C. Black, Ltd.) now in its third edition. He also wrote on the glaciation of the Lake District and of the Isle of Man and on the history of Cumbrian rivers. His official work was very varied, but his principal contributions to Survey literature were his "Iron Ores of Cumberland" and the memoirs on the Whitehaven coalfield which he edited and in large part compiled. He was awarded the degree of Sc.D. (Cambridge) in 1924, and the Bigsby Medal of the Geological Society in 1927. The Royal Geological Society of Cornwall conferred on him the Bolitho Medal in 1933. In 1933 he was elected fellow of the Royal Society, and he served on the Council. In 1935 he delivered the Cantor Lectures on "Underground Water Supply" at the Royal Society of Arts; and he was actively engaged in the work of the Inland Water Resources Committee of the Ministry of Health. He served also on the National Committee of the Union of Geodesics and Geophysics and was a member of the Sub-Committee on Vulcanology and Hydrology.

Dr. H. A. D. Jowett

IN a characteristic appreciation of the late Sir Henry Wellcome, published in *The Times* of August 3, Prof. H. E. Armstrong points out that he chose his men with great shrewdness. It is with great regret that we have to record, so soon after the loss of Sir Henry Wellcome himself, the death of one of these chosen helpers, as the result of a motor accident on Monday, August 10. Dr. Jowett was born at Dorchester in 1870, but received his education at the Royal Grammar School, Lancaster, and remained in that town until 1891, when he gained a Bell Scholarship offered annually by the Pharmaceutical Society and became a student in the Society's College in Bloomsbury Square. He took his diploma in due time, along with most of the College prizes, and was awarded the Redwood Scholarship, which gave him entry to the Society's Research Laboratories, where he remained until 1896, working on aconitine and atisine, the latter being the subject of the thesis which he presented successfully for the London D.Sc.

In that year, Jowett became chief assistant in the newly-founded Wellcome Chemical Research Laboratories. There he spent ten busy and fruitful years, during which he made contributions of the first importance to our knowledge of the chemistry of the alkaloid pilocarpine, the hormone adrenaline and some of the naturally occurring glycosides and anthraquinone derivatives, chrysophanic acid, emodin and aloin. The work on pilocarpine and adrenaline was not only important in itself, but also it stimulated interest in the glyoxaline nucleus and in pressor amines, subjects which were to occupy both chemists and pharmacologists in the Wellcome Laboratories for some years to come. Jowett also began during this period those interesting investigations on the effect of change in structure in the tropeines on their mydriatic action.

In 1906 Jowett left London for Dartford to inaugurate the Experimental Department of the Wellcome Chemical Works, and a year later was appointed works manager, but was still able for some years to continue with collaborators the researches started in London. Having acquired a considerable reputation as an investigator, Jowett must have accepted his new post with some misgivings, but he soon justified his choice, and under his management the manufacture of fine pharmaceutical chemicals increased slowly but surely, and when War broke out in 1914 the works were ready to take a great part in the manufacture of those essential synthetic drugs which the nation had up to that time been content to import. In a very short time British equivalents for such complex drugs as 'salvarsan' and 'neosalvarsan' were being manufactured, and numerous other fine chemicals were added as required.

This development has continued steadily to the present time, and in this connexion it is only necessary to refer to the rapidity with which the manufacture of new products, such as insulin, ephedrine and ergometrine, has been undertaken and to the successful research work on cardiac glycosides and ergot

alkaloids now in progress in the experimental laboratories at Dartford, to show that his inspiring personality was as vigorous as ever after forty years service to the Wellcome Foundation.

Dr. Jowett was not only skilled in chemistry, administration and the management of men: he became a motorist almost as soon as motor-cars were available; he was a keen golfer and an enthusiastic Wagnerian, and in recent years he developed a great interest in local government, becoming a member of the Dartford Borough Council, where as chairman of the Health Committee his administrative experience and scientific knowledge were of great service to his fellow citizens.

Dr. Jowett's friends are not likely to forget his achievements, but they will remember even more vividly his kindly and lovable personality.

WE regret to announce the following deaths:

Prof. F. Breinl, professor of hygiene in the German University of Prague, an authority on bacteriology, on July 29.

Prof. B. G. Cormack, emeritus professor of botany in the Anderson College of Medicine, Glasgow, on August 19, aged seventy years.

Dr. W. G. Plummer, assistant keeper in the Science Division (Physics and Geophysics) of the Science Museum, South Kensington, on August 2, aged thirty-eight years.

W. Rintoul, O.B.E., a director of research of Imperial Chemical Industries, Ltd., formerly manager of the Ardeer factory of Nobel's Explosives Co. Ltd., on August 24, aged sixty-six years.

News and Views

Synthesis of Vitamin B₁ (Antineurin)

SINCE the realization that the molecule of vitamin B₁ contains two heterocyclic rings, a substituted pyrimidine and a substituted thiazole, intensive research has been directed towards establishing the positions of the substituent groups and the method of combination of the two rings. According to a paper of which a brief abstract appears on p. 372 of this issue, Prof. Williams and his collaborators at Columbia University have now succeeded in isolating a compound which is chemically and physiologically identical with the natural vitamin. Several groups of workers in Great Britain and Germany have been working at the same problem, but they will doubtless be among the first to congratulate the American chemists concerned on a brilliant and important piece of organic synthesis. It may be noted that this achievement means that, with the syntheses of ascorbic acid, lactoflavin, vitamin D and vitamin B₁, four vitamins have now been produced from completely inactive organic reagents by purely chemical means.

New Fossil Anthropoid Skull from South Africa

A DISCOVERY is announced from South Africa which, if first impressions are confirmed by more detailed examination, may go far towards clearing up a point which has been a matter of acute anthropological controversy for more than a decade. Dr. Robert Broom, of the Transvaal Museum, and his colleagues, it is reported in a dispatch from the Johannesburg correspondent of *The Times* in the issue of August 26, have discovered in the Sterkfontein caves near Krugersdorp, a natural cast in limestone of the brain of an advanced type of ape and a number of fossilized bones of the skull, including jaws and teeth. It is anticipated that this new evidence will prove of importance in its bearing upon the status of the phylogeny of man and the

great apes, and more especially on the position of the Taungs skull. It will be remembered that, when that fossil was found in 1924, some doubt was expressed as to how far the approximation to the human type in its characters stressed by Prof. Raymond Dart, by whom it was discovered, was due to its immaturity. The young of the chimpanzee, it was pointed out, is well known to exhibit pseudo-human characters, which disappear as maturity approaches; and it was agreed that the Taungs skull was that of an individual of not more than six years of age. As the Sterkfontein specimen, it would appear, is adult, a comparison with the Taungs skull may determine these uncertainties, and at the same time afford an indication of the relation of these fossil types to existing anthropoids as well as to early forms of man.

Roman Leicester—a National Asset

THE fate of Roman Leicester, which now hangs upon the decision of the City Council, is a problem in which the nation is no less deeply concerned, though from a slightly different point of view, than the city itself. A site in the heart of the city's oldest relics, purchased at a cost of £24,000 for the erection of public baths, has yielded on excavation remains of the Roman period, more particularly of the forum, the centre of municipal life, which in certain respects are unique (see *NATURE* of July 11, p. 69). While on one hand the local authority may allow due weight to the advantage to Leicester in the possession of this unique and irreplaceable monument of the past, yet local pride must inevitably be tempered by a sense of the duty of trustees of public funds; on the other hand the nation at large is a custodian of such treasures as this for the benefit not only of contemporary archaeological studies, but also of posterity. The most meticulous records of excavation, however valuable for scientific study, cannot take the place of relics

of antiquity which have been destroyed. Apart from the educational appeal of the buildings in their original relation, and so far as possible, in an appropriate setting, they will afford the scholar a constant inspiration to further research, as well as provide a source of evidence for correcting or reconstructing theory in the light of later knowledge, such as never can be derived from a written record, photograph or drawing. The excavations now in progress may reinforce the argument, or should the City's decision be adverse to preservation, justify a delay, which will then be urged, pending an appeal for funds from outside sources for the complete excavation of the site in the coming year. The conflict between duty to local economies and the preservation of antiquities, which are national in their interest, is one which is likely to arise with increasing frequency in view of the rapid development of urban and suburban properties now taking place. When such developments affect relics of wide historic and scientific interest, as at Leicester, it is a question whether national funds should not be called on to assist.

Potters of Lincoln

MUCH interest is attached to the discovery of a Roman potter's kiln at Lincoln, fully loaded with a light cream ware, and fired, but unopened. It affords evidence that an industry, which discoveries in 1932 have shown to have been in existence here in the Middle Ages, was also extensively practised in the Roman period. Quite possibly, as 'Pottergate Arch' nearby, and the occurrence of 'Pottergate' as a street name in the thirteenth century would suggest, the industry may have survived throughout the interval between medieval and Roman times with little or no interruption. The kiln was discovered, it is reported in *The Times* of August 21, on a site in Cathedral Street. It contained vessels of the mortaria type, the large shallow basins with a heavy rim, in which the Romans used to grind their food. The kiln was a hole in the ground four feet long and two feet wide, with a well-fired wall on two sides. It was roofed over with a whitish clay mixed with sand; and it contained four stacks of pottery, which had been considerably crushed. Curious short pipes, of which the use is obscure, were also found. Many of the vessels were stamped with the potter's mark, which, when deciphered, should afford a clue to the distribution of Lincoln pottery in Britain. The medieval pottery, which was found in this area, was attributed to the fourteenth century. No doubt the potters of that date drew their clay from the same source as their Roman predecessors. This in itself would be sufficient to account for the persistence of the industry in this area.

Minoan Influences in Ancient Syria

SIR ARTHUR EVANS, commenting on the results of Sir Leonard Woolley's recent archaeological investigations in Syria (see *NATURE* of July 4, p. 20 and August 8, p. 235), pronounces the Minoan impact on inner Syria at so early a date, for which the ceramic

relics from Tell-Atchana afford evidence, as "a new historic fact of far reaching importance and revolutionizing all previous ideas". It is, he points out in *The Times* of August 19, a step forward of at least two centuries; for although there are no actual imports from Minoan Crete, the starting point in repeated examples of pottery reflecting Cretan models must certainly touch 1700 B.C. Sir Arthur bases this conclusion on the chronological datum of remains of cups, of somewhat thin make, showing white rosettes on a black ground, recalling the "egg-shell ware" bowls of the great age of Minoan Crete of the Second Middle Minoan period, which goes back to the eighteenth and nineteenth centuries, but in Syria equating with the succeeding Third Middle Minoan style. At the same time, mixed influence is to be seen in the combination of arcaded zones, characteristically Minoan, with highly conventionalized ducks, which find a parallel in early Palestine, while one of the sherds depicts an uprearing goat charged by another, whereas animal designs were excluded from the vase painting of Cretan Palace art. In concluding with an analysis of motifs, which point to a fusion of Cretan and indigenous religious and symbolic ideas, relating to the cult of the double axe, and reference to tradition of a royal alliance with Cyprus, Sir Arthur holds out the alluring possibility that the spade may yet uncover a royal sepulchre at Tell-Atchana.

Special Exhibit at Ipswich Museum

IN 1917, Mr. Reid Moir announced the discovery of flint implements, mammalian and human bones, and fragments of rough pottery, in the lower of two superposed 'floors' in a brickfield of Messrs. Bolton & Co. at Ipswich. These occupation levels occurred in sand, and were overlain by a considerable thickness of hill-wash, while the excavations carried out showed that the now dry valley in which the discoveries were made has been deepened by erosion since the floors were occupied by man. Similar results were obtained, at a later date, by Mr. J. P. T. Burchell, in his researches at Ingress Vale in the lower Thames Valley. Here, at the base of an extensive section of sub-aerial loam, surmounted by a hill-wash containing rafts of Coombe Rock, was found a prolific floor, with flint implements, flakes, and fragments of primitive pottery. The third site, where a similar association of relics occurred, was discovered and investigated by Mr. and Mrs. MacAlpine Woods in a dry valley at Bovey Lane, Beer, Devon. In this case, a hill-wash, some 11 ft. in thickness, contained large numbers of flint artefacts, a few examples of bones and teeth of animals, and some pieces of rough pottery. Through the kindness of the discoverers, the Ipswich Museum now possesses representative series of the specimens mentioned, and is making a special exhibition of them. The matter is of considerable interest to archaeologists as, in each case, the flint implements may be said to resemble, in their forms, those of Lower and Upper Aurignacian times, and are not associated with any microliths. Moreover, there seems good reason to believe that the widespread deposits in which the relics were embedded

are of relatively considerable antiquity, and represent the results of geological activity, including an epoch of low temperature, in eastern and southern England.

Current Science

WITH the publication of its July issue, our Indian contemporary, *Current Science*, enters upon its fifth year. Founded to supply an obvious need in the scientific renaissance of India, *Current Science* is almost unique in that its editor is assisted by a board comprising the majority of the best-known Indian men of science. The July issue contains much of interest not only to India but also to the West. The leading article comments on the inauguration, by his Excellency the Viceroy, of a Nutrition Advisory Committee. The outstanding investigations of Sir Robert McCarrison in Coonoor have in recent years focused the attention of Indian public opinion upon the importance of adequate feeding for national efficiency. Inadequate nutrition, combined in many areas with endemic malaria, is known to be the cause of the poor physique of many classes. The Royal Society is now assisting in the investigation of the intricate problems of malaria control, and will doubtless co-operate with this new Advisory Committee. Another article in the July issue, of more than local interest, is the summary of a lecture given by Prof. Birbal Sahni on the Karewas of Kashmir, where the geology of the Karewas series in the Himalayas is discussed from the point of view of the botanist. We congratulate the editor of *Current Science* on the high standard of the journal, which, if maintained, ensures its continued success.

Philosophy and Quantum Theory

IF philosophy is, as Descartes claimed, the 'universal science', it should be able to assimilate all new discoveries in the special sciences. There was not much difficulty in dealing with classical physics. When the theory of relativity was put forward, it was soon found that philosophical ideas could be rearranged to find it a place, and even a welcome, but what is to be the attitude to a theory which denies continuity and determinism? An attempt, admittedly incomplete, to answer these questions has been made by R. Dugas ("La méthode dans la mécanique des quanta". *Actualités scientifiques et industrielles*, 283. Paris: Hermann et Cie., 1936). Following Meyerson, complete indeterminism is rejected, and replaced by aggregates ruled by laws of probability. If there is no law, there is no science. Other difficulties arise when we try to discover the basis of Schrödinger's equation. Are we to say that our equations know more than we do, and that, without understanding them, we can rely upon them to furnish the correct results? Are we to believe in *panmathesis*, and in a universe in which electrons and matter have no real existence, but are merely names for mathematical symbols? The trouble with questions such as these is that all the available evidence appears to point to the conclusions that are repugnant to common sense.

Photomicrographic Reproduction of Scientific Papers

FOLLOWING on the formation of the Documentation Division of Science Service, a programme of testing mechanical methods of applying photomicrographic duplication of scientific literature is being developed, including a camera for copying upon 35 mm. film, supplementary apparatus such as a book holder for the camera, film container, etc., a reading machine, microfilm viewer, projection printer, and developing and processing apparatus for 35 mm. microfilm and paper projection points. Procedure has already been developed for the publication of scientific material otherwise unable to receive publication in full. Editors of journals or institutions deposit typescripts of those papers or portions of papers which they are unable to publish promptly or completely. With an abstract or summary, they publish a statement that additional matter, illustrations, tables, etc., are available on request from Science Service if the document number is stated and the price remitted. The document is assigned a number by Science Service and on receipt it is photographed on 35 mm. film master negative. The original document is then deposited elsewhere as a safeguard. The photomicrographic duplication is economical when up to twenty-five copies at a time are required and has the further advantage that the document is continuously in print as the negative can be used to supply a copy on demand at any time.

THE relation of microfilms or photo-copies prepared in this way to priority in scientific discoveries has been raised. Opinion is expressed in a note issued by Science Service that microfilm or photo-copy publication is a printed publication in the true sense, and that by considerably reducing the time between the submission of a paper to a journal and the date of publication of the discovery announced therein, this type of publication will be of great assistance in eliminating controversies such as have arisen in the past concerning individual claims for priority in making discoveries. If any doubt exists as to whether photomicrographic publication is a 'printed publication', it is urged that this doubt could be removed by scientific societies merely agreeing among themselves that, in so far as priority in their fields is concerned, photomicrographic publication should be accorded the same weight and effect as publication in a printed journal.

Wind Erosion in South Australia

WIND erosion is becoming an increasing danger in the semi-arid regions which form the world's chief granaries. In North America, the Argentine and to a less extent in Russia, the fertile prairie soils are rapidly being swept away as the result of destroying the original grass cover. A similar fate is overtaking vast pastoral regions in South Australia, due to overstocking. The gravity of the situation is revealed in a note by F. N. Ratcliffe, received from the Commonwealth Council for Scientific and Industrial Research. The worst erosion has been in the 'bush' country, where twelve drought years have so

lowered the stocking capacity that overstocking on established farms is now almost unavoidable. Rabbits have added to the evil, the vegetation cannot recover after grazing, and natural regeneration of both shrubs and grasses has virtually ceased. Large areas have become barren deserts, and no measures are available for their reclamation. The evil might be checked by adopting a lower stocking policy; but the only hope for the already denuded areas is to introduce perennial exotic plants capable of stabilizing the large sand drifts, and withstanding rabbits and a very low and uncertain rainfall. The chance of discovering such plants is remote, and even if discovered, "there would remain the problem of their dissemination through vast areas with no regular growing season and an unimproved capital value rarely exceeding 2s. per acre".

Mining in Canada

WE have received the Report of the Department of Mines of the Dominion of Canada for the fiscal year ended March 31, 1935, and taken as a whole it may be said to be thoroughly satisfactory. The Report shows that the rise in the price of gold has caused renewed activity in that industry and states that "Canada's gold industry is contributing to the prosperity, not only of the communities in which operations are centred, but to the industrial life of the nation as a whole". Canada apparently is also reopening some of the silver camps for which it was famous a few years ago, but the "Department's work in fuels and non-metallies is becoming of increasing economic importance", and there has been a relatively small number of ore treatment investigations in connexion with base metal ores. There are full reports of the various divisions of the Department of Mines, commencing with a Bureau of Economic Geology, the National Museum of Canada and Mines Branches proper, together with an Explosives Division, an Editorial Division and an Accounting Division, which latter shows that something like a million dollars was available for the expenditure of the Department of Mines, and that nearly all of it was utilized. It is interesting to note that the Fuels and Fuel Testing Division was busily engaged throughout the year in question.

Cotton Research in India

INDIA is the second largest cotton growing country in the world, and the importance of the industry led the Indian Cotton Committee to set up a Technological Laboratory at Matunga some ten years ago. Research work and tests of direct importance to the cotton breeder, merchant and mill owner have been carried out in collaboration with the provincial agricultural departments, and a brochure has just been published by the Committee giving a full account of the activities of the Laboratory since its inception (Bombay: Indian Central Cotton Committee. 2 rupees). The two main objects of the work are to undertake spinning tests on improved varieties of cotton, and to establish relationships between the measurable fibre characteristics and the spinning quality. This second object aims at dispensing with

the necessity of making spinning tests on large numbers of new strains, as it is hoped to be able to assess the performance of the cotton from a knowledge of its fibre properties. The development of the work may be judged from the fact that during 1933-34, 166 samples were tested in connexion with trade and technological problems, compared with only 28 in 1924-25, while as regards agricultural samples, 366 were tested in 1933-34, compared with 46 in the 1924-25 season. The problem of averting the possible danger of the introduction of the cotton boll-weevil through imported American bales has been successfully attacked. A satisfactory method of fumigation has been developed, and legislation enacted to ensure that all cottons imported from America are so treated. The brochure concludes with a complete list of publications issued from the Laboratory since 1925.

The Science Museum Library

ON entering a library for the purpose of obtaining information on a given subject, the first things the visitor wishes to know are what books or pamphlets the library possesses relating to the subject, and how is he to obtain them. There are usually card indexes available, but even with these at his disposal the reader may well be at sea unless he possesses a key to the system on which they are arranged. The publication of a new edition of the "Classification for Works on Pure and Applied Science in the Science Museum Library" (London: H.M. Stationery Office. 5s. net.) provides such a key to the finest science library in Great Britain. It should be studied by every one who uses the Library. It contains an explanation of the Universal Decimal Classification of the International Institute of Documentation in use at the Library, a list of about six thousand classes into which knowledge is divided for the purpose of indexing, and a copious alphabetical index comprising some five thousand entries. In the preface to the "Classification", Dr. S. C. Bradford says: "The titles on the cards in the Subject Catalogue are numbered and arranged in accordance with the Universal Decimal Classification. Under each number the titles are in chronological order. To ascertain what books the Library possesses on a given subject, readers are recommended to look first in the index, and then refer to the classification, before consulting the cards." By following this advice, those not already familiar with the system used in the Science Museum Library will undoubtedly save themselves both time and labour. It may be added that, in the last Report on the Science Museum, it was stated that the Library now possesses 252,515 volumes, the total of periodicals currently received is 9,468, while the Subject Matter Index contains 2,248,423 references.

Progress in France of Electricity Supply

AN account of electricity supply in France appears in *World Power* of July, as a translation of a paper in *La Journée Industrielle*. In 1923 the total installed capacity of electrical generating stations was 4½ million kilowatts. This increased to 10½ million in 1935. There are 15 thermal and 5 hydro-electric

stations each having a capacity greater than 100,000 kw. The capacity has increased more rapidly than the output owing to the necessity of keeping a large reserve of power to meet sudden fluctuations in the consumption. In Paris, for example, the rate of consumption varies between 50,000 kw. at 3 a.m. and 340,000 kw. at 5 p.m. The rate of consumption of hydro-electric power is now greater than that of thermal power. It is noteworthy that the total length of the distributing lines is increasing more rapidly than the consumption of power. This is due to the increasing number of small consumers and to the fact that, as the supply service is extended to the more remote regions, longer lines are needed to reach new users. At present it is necessary to lay 46 metres of low tension line, on the average, to supply each new consumer, whereas in 1923 the length of line required was 13 metres. The large industries consume 7,100 million kwh. per annum and electrochemistry and electrometallurgy together take 2,200. Lighting and domestic supply take 1,800, small industries 1,000 and traction 900. There are now 35,369 communes supplied with electricity, and only about 2,600 not so provided.

Protection against Gas Attacks

THE Socialist Medical Association has issued a booklet entitled "Gas Attacks: Is there any Protection?" (London: Lawrence and Wishart, Ltd. 6d.). It is maintained that air-raiders are certain to penetrate our defences, and will not hesitate to employ a combination of high explosives, fire and gas in their attacks, against which the only efficient protections are respirators and gas- and bomb-proof self-contained dug-outs. The booklet issued by the Home Office, "Anti-Gas Precautions and First Aid for Air-Raid Casualties", is criticized, and is considered to give an incorrect impression of the dangers of war gases and possibilities of protection, and that the defences proposed, even if they could be generally adopted, would be inadequate. Dr. Sommerville Hastings contributes an introduction, the nature of the gases employed and their effects are described, and the available means of protection and the treatment of gas casualties are discussed.

Bulletin of the Metchnikoff Institute of the Ukraine

THE Metchnikoff Institute of the Ukraine has commenced the issue of a monthly bulletin (*Bulletin de l'Institut Metchnikoff*) devoted in the main to bacteriological and immunological papers from the Institute, written in French, English and German. In an editorial note to the first number (April 1936), it is remarked that until 1917 bacteriology had made slow progress in Russia, but that since that time many new institutes have been established and the active roll of bacteriologists and epidemiological experts has very greatly expanded. The nineteen extremely brief papers published in the first number are written in summary fashion without bibliographies, but any efforts that facilitate the introduction of Russian work to non-Russian readers are to be heartily welcomed.

The Aquarist and Pond-Keeper

THE *Aquarist and Pond-Keeper*, incorporating the *Reptilian Review*, in the March-April number, 1936, has various improvements, including a new cover design. Specially striking is a collection of photographs occupying two pages, which with the illustrations to the article on reptile hunting in Britain by A. E. H., depict the whole of our native species of reptiles and batrachians. Mr. E. Bridgstock-Choat, honorary curator of the Erith Museum, contributes an article entitled "The Pond Hunter", which will be continued, and papers from various other workers deal with fishes, fish-breeding, ponds and water gardening and various allied subjects.

Official Statistics

ATTENTION may be directed to the publication of the Guide to Current Official Statistics for 1935 (London: H.M. Stationery Office. Price 1s.). The arrangement is the same as in previous years. The greater part of the volume is occupied by an alphabetical range of subjects with reference to the appropriate publication. This is followed by a list of publications arranged under departments. The volume is invaluable for quick reference, and reveals the great range of matters on which statistical and other official information is available.

Post-graduate Medical Research

THE Medical Research Council has decided to institute a series of studentships and fellowships to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Six post-graduate studentships are therefore offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in research methods. Each fellowship will be tenable for one year at the value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Fireball over Yorkshire

THE occurrence on August 18 at about 22^h 23^m (Summer Time) of a brilliant object, evidently a fireball or particularly bright meteor, has been referred to by several correspondents in the *Yorkshire Post*. The accurate observation of the apparent path of a meteor requires a trained observer, and it is to be expected that accounts supplied by casual eye-

witnesses are often vague, conflicting, and quite unreliable for the data required to fix the real path above the earth. It seems, however, very probable that the fireball which lit up the countryside from which it was seen (including North Yorkshire, Derbyshire and Westmorland) was associated with the Perseid shower of meteors. This shower, which provides a high maximum frequency of meteors between August 10 and 12, is really operative from about mid-July until after mid-August; during this period the radiant point moves progressively from a position at about R.A. 1^{h} : Dec. $+50^{\circ}$ to R.A. 4^{h} : Dec. 65° , or from a position in the constellation Andromeda, through Perseus (which gives the shower its name) to Camelopardus.

The Night Sky in September

THE night sky of September offers a rich variety of objects for observation with slight optical aid. Some of the most attractive of the constellations are visible; there are star fields of the Milky Way, the Andromeda Nebula, the variable star, Algol, the Pleiades, some of the best known double stars and the largest two major planets. Between the first and last days of the month, the days shorten in the latitude of London by nearly two hours. On Sept. 23^d 5^h the sun enters, at the autumnal equinox, the sign Libra. Full moon occurs on Sept. 1^d 12^h and again, as the Harvest Moon, on Sept. 30^d 21^h. Of the planets to be observed, Venus still sets in the early twilight, but Jupiter is a bright object low in the south-west during the early evening. There is yet time, though very limited, for observing some interesting phenomena—transits, occultations and eclipses—associated with the four inner satellites. Particulars will be found on p. 615 of the *Nautical Almanac* for 1936. Saturn is above the horizon all night; on September 12 it is in opposition at a least distance from the earth of about 800 million miles. The rings appear nearly closed, the minor axis subtending an angle of only $1\frac{1}{2}$ seconds of arc. Mars is a morning star, and will be in conjunction with the bright star Regulus on September 24, when the angular distance between planet and star is less than 1° . Uranus is in Aries, and can be found near the 6th magnitude star ω Arietis, which the planet resembles when viewed with binoculars; but a 2- or 3-inch telescope will show the planet's disk of $3\frac{1}{2}''$ in diameter. The light variation of Algol (β Persei) may be observed near the following times of minima: Sept. 3^d 3^h, 6^d 0^h, 26^d 2^h, 28^d 23^h, Oct. 1^d 19^h (add 1^h to convert to Summer Time). The following double stars are suitably placed for observation during September: α Herculis (separation of components $4\frac{1}{2}''$), ϵ Lyræ (3' separation for the wide components each of which is a double of $2\frac{1}{2}''$ and 3" separation respectively), β Cygni ($34''$) and γ Delphini ($11''$).

Announcements

PROF. MAX PLANCK, president of the Kaiser Wilhelm Society for the Advancement of Science, has been nominated doctor *honoris causa* by the Faculty of Philosophy of the University of Graz.

THE 1936 American Physical Education honorary award for achievement has been divided between the twin brothers, Dr. Edgar and Dr. Edwin Fauver, directors of physical education at Wesleyan University and Rochester University, respectively.

ON the occasion of the recent celebration of the twenty-fifth anniversary of the German Statistical Society the following were nominated honorary members: Prof. Sigmund Schott, director of the Mannheim Statistical Office; Dr. Friedrich Prinzing, of Ulm; Dr. Kovacs, president of the Hungarian Central Statistical Office, Budapest; and Dr. Savorgnan, president of the Italian Central Statistical Office, Rome.

DR. WILLIBALD SCHOLZ, professor of neurology and psychiatry at Munich, has succeeded the late Prof. Spielmeier as director of the Department of Cerebral Pathology of the German Research Institute of Psychiatry, Kaiser Wilhelm Institute, Munich.

A NUMBER of public health courses have been instituted in Holland for training civilians in protecting themselves against attacks from enemy aeroplanes.

A SIX-year study of the role of diet in the last half of adult life will be undertaken at the New York State College of Agriculture at Cornell University. The Rockefeller Foundation has contributed 42,500 dollars to the support of the study.

THE second Italian Congress of Radiology will be held at Modena on September 20-21 under the presidency of Prof. Ruggero Balli, director of the Institute of Radiology. Further information can be obtained from the general secretary, Dr. Marco Lenzi, Istituto di Radiologia, Modena.

PROF. PAVLOV'S widow has presented the first batch of papers formerly belonging to her husband to the archives of the Academy of Sciences of Soviet Russia. They consist of about 2,500 letters from Russian and foreign men of science. Most of them relate to the years following the Revolution, while among the earlier ones are several from Metchnikoff and other famous men of science who corresponded regularly with Pavlov.

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

An assistant (III) at the Ditton Laboratory, East Malling, Kent (refrigeration)—The Superintendent, Ditton Laboratory, East Malling, Kent (August 31).

Three inspectors (agricultural and live-stock) in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, 2 (September 1).

A civilian education officer in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 14).

A visiting tutor for educational psychology in the Catholic Training College for Women, Cavendish Square, London, W.1—The Principal.

Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 369.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Structure-Factor Graphs for Crystal Analysis

WHEN unit cell and space group have been determined in crystal analysis by X-rays, the investigator tests various configurations of the atoms in the unit cell in order to obtain one which explains satisfactorily the observed strength of the diffracted

clinic crystals on 'a' or 'c', and of orthorhombic crystals. An atom with co-ordinates x, y , along with the three other atoms to which it is related by the operation of the symmetry elements, gives a structure factor $4 \cos(2\pi hx/a) \cos(2\pi ky/b)$ for the reflection (hkl). The function $\cos(2\pi hx/a) \cos(2\pi ky/b)$ is plotted in Fig. 1 (b) for the case $h = 2, k = 3$. In the graphs actually used in analysis contours are drawn for intervals of 0.1, but in this small-scale sketch only the zero lines and contours for 0.5 have been drawn. In the complete graph each small cell contains contours like those in Fig. 1 (c), suitably modified in horizontal and vertical scale. A set of graphs is prepared for all low values of h and k .

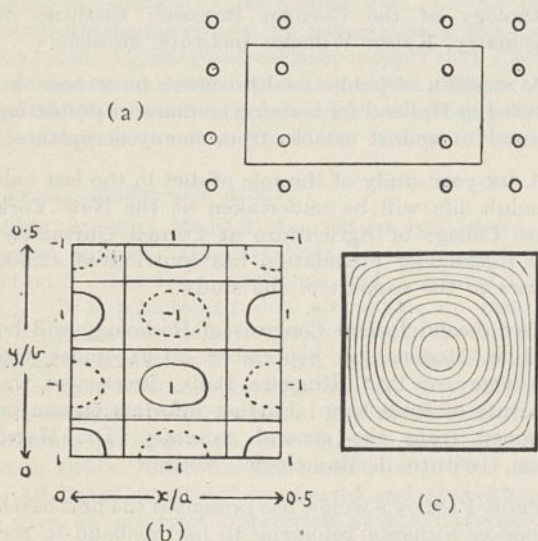


FIG. 1.

beams with various index-triplets (hkl). For each configuration and each reflection (hkl), an appropriate 'structure-factor' can be calculated by the laws of optical interference. Large structure-factors correspond to strong reflections, and small structure-factors to weak reflections.

Once an approximation to the structure has been obtained, the fixation of the precise atomic positions is readily carried out by Fourier synthesis. The search for an approximate structure, however, is often extremely laborious, since in most cases a method of trial and error has to be used, and the structure-factor has to be computed for each tentative configuration. It is the purpose of this note to point out how greatly this labour is reduced by the use of *contoured graphs* of structure-factor.

It is usual to consider the projection of the structure on each face of the unit cell in turn, using the reflections around the corresponding zone in each case. 'General' reflections can then be used to test the structure so deduced. Although the number of space-groups is large, the number of symmetry types in the plane groups is restricted. A few formulæ for the structure-factor cover all cases.

As an example, the symmetry scheme shown in Fig. 1 (a) frequently appears in projections of mono-

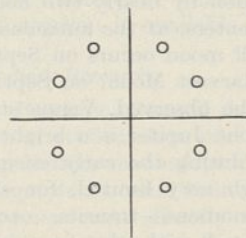


FIG. 2 a.

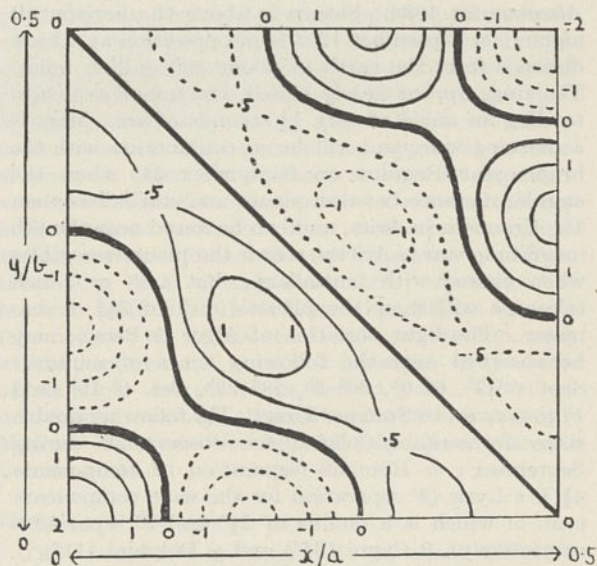


FIG. 2 b. Contours of the function $\{\cos(4\pi x/a) \cos(6\pi y/a) + \cos(6\pi x/a) \cos(4\pi y/a)\}$.

When an atomic configuration is being tested, the x/a and y/b co-ordinates of its atoms are plotted on a transparent sheet which fits over the graphs. Structure-factors can be read by inspection to two

figures, an amply sufficient accuracy. The principal merit of the graphs, however, is that the investigator can judge how the tentative configuration should be modified in order to make its structure-factor correspond to the observed value for each reflection, since the effect of moving an atom in a given direction and by a given distance is shown by the graph. The advantage of being able to do this will be appreciated by anyone accustomed to X-ray analysis.

By moving the origin from centre to corner of a small cell, the same graphs give values of $\sin(2\pi hx/a)\sin(2\pi ky/b)$. A single set of graphs, in fact, covers all cases of monoclinic and orthorhombic crystals for which the projection has a rectangular outline and a centre of inversion.

The advantage of the graphs is even greater in projections of tetragonal and hexagonal symmetry, when the atoms may be in groups of eight or twelve. The (230) graph for the tetragonal complex of Fig. 2a is shown in Fig. 2b. Such a graph considerably facilitates the adjustment of atomic positions. There are plateaux, for example, where the contribution of an atom varies very slowly, so that atoms in these regions give an approximately known contribution and attention may be concentrated on other atoms in 'sensitive' positions.

Trial has shown that analysis can be much more rapidly carried out with the graphs than by processes of calculation.

W. L. BRAGG.

Physical Laboratories,
University,
Manchester.
July 27.

Molecular State of Proteins in Mixtures and Concentrated Solutions

By means of the Svedberg high-speed ultra-centrifuge it is possible to analyse mixtures of different molecular species, since the sedimentation involves a partial separation of the different sizes present. The concentration of the components may therefore be calculated from the sedimentation diagram. But during the study of protein mixtures in the ultra-centrifuge it has often been observed that the concentration of the different sedimenting molecules thus calculated were not the same as those determined analytically. Generally the apparent concentration of the faster sedimenting molecule was smaller, when calculated from the sedimentation diagram, whereas it was higher for the slower sedimenting molecule. McFarlane¹, who first studied the problem on some artificial serum mixtures, thought that the effect was due to some specific interaction between the albumin and the globulin. Later, R. A. Kekwick and I studied some mixtures of serum-albumin and lactoglobulin. In this case serum-albumin, the faster sedimenting molecule, is found in too low concentration, and the lactoglobulin is found in too high concentration. From these experiments I concluded that the phenomenon was caused by some medium effect produced by the slower sedimenting protein molecules on the faster sedimenting ones, and that the effect was due to a real dissociation of the faster sedimenting molecules. If this is true, one would expect that it would be possible to produce the effect by means of lower molecular substances related to proteins, such as amino acids, polypeptides and protamines.

For the first two groups of these substances there was a measurable although very small effect. In the case of the protamine studied (clupein) the effect was very strong with serumalbumin, where it gave rise to new molecules with s_{20} (= sedimentation constant) of about 1×10^{-13} besides the ones with the normal s_{20} (4.5×10^{-13}). If we call the serum-albumin molecules with the normal s_{20} , A , and those of the dissociated serumalbumin, B , then the concentration ratio between these as calculated from the sedimentation diagram was: for a 5.3 per cent clupein solution $B/A = 1.58$, for a 2.65 per cent solution $B/A = 0.90$ and for a 1.1 per cent solution $B/A = 0.36$. From these figures it is seen that the effect is by no means negligible since the dissociation product of serumalbumin in the more concentrated clupein solution is present in higher concentration than the undissociated serumalbumin. It is also very remarkable that all the sedimentation diagrams show only the presence of molecules with $s_{20} = 1 \times 10^{-13}$ and $s_{20} = 4.5 \times 10^{-13}$ (besides a small amount of some association products); this probably indicates that the dissociation process always gives rise to molecules of the same size (perhaps one eighth of the original value). Some experiments with haemoglobin show that this protein too is dissociated in the presence of other proteins and clupein, but here the sedimentation constant indicates that the dissociation at first gives molecules of half the original size, independent of whether lactoglobulin or clupein is used.

As the effect seems to be of a more general nature (whether it is a dielectric or chemical effect or a combined effect is at present impossible to decide) it is to be expected that it may also take place in a more concentrated solution of a uniform protein, and these solutions should therefore give a decreased molecular weight with increasing protein concentration. This may at least partly explain the fact that several investigations show that the proteins are behaving osmotically abnormally in that the ratio π/c (π = osmotic pressure, c = concentration of protein) increases with increasing protein concentration, as it should do if the molecular weight is not constant, but decreases with increasing concentration.

Information about this effect may be of value in explaining some of the biological processes, where we are dealing with more or less concentrated protein solutions.

Further details will be given in a forthcoming paper in the *Biochemical Journal*.

KAI O. PEDERSEN.
Laboratory of Physical Chemistry,
University of Uppsala,
Sweden.
July 26.

¹ See, for example, A. S. McFarlane: *Biochem. J.*, **29**, 407 (1935).

Effect of Phenylacetic Acid on the Growth of Tomato Plants

MUCH interest has been taken in the action on the growth of plants of various organic substances which has been described by the workers at the Boyce Thompson Institute^{1,2}. They apply these substances in lanolin preparations to plants, or as a water solution added to the soil or injected into the stem; the main responses of the treated plants being

epinasty of the leaves, swellings and proliferations of the stems and petioles, and formation of roots on or near the treated part. In the course of some tests carried out at East Malling Research Station, using phenylacetic acid, I sprayed a batch of tomato plants with a 0.1 per cent solution in water, while control plants were sprayed with water containing a little alcohol. The solution was prepared as described by

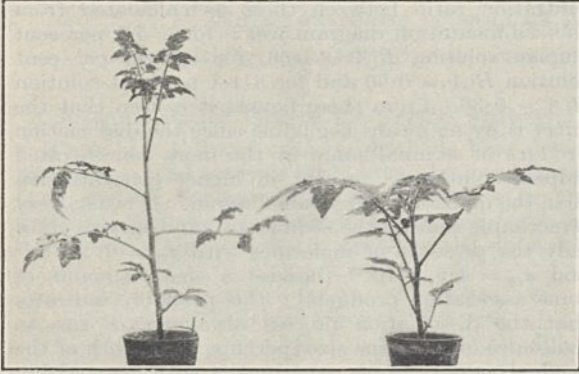


FIG. 1. The plant on the left has been sprayed daily for two weeks with 0.1 per cent phenylacetic acid. Control on right sprayed with water.

Hitchcock and Zimmerman³. By the spray method, the amount of growth substance applied can be fairly accurately controlled. Entry was very rapid; epinasty of the leaves being visible after one hour in a greenhouse at a temperature of about 20° C. The plants were treated in the morning, and by the next day the leaves had fully recovered; moreover, very little stem bending had occurred, showing that the distribution of the growth substance was uniform throughout the stem. The treatment was continued daily, and groups of plants were harvested weekly; the fresh and dry weights being determined. Fig. 1 shows a treated and a control plant at the end of two weeks.

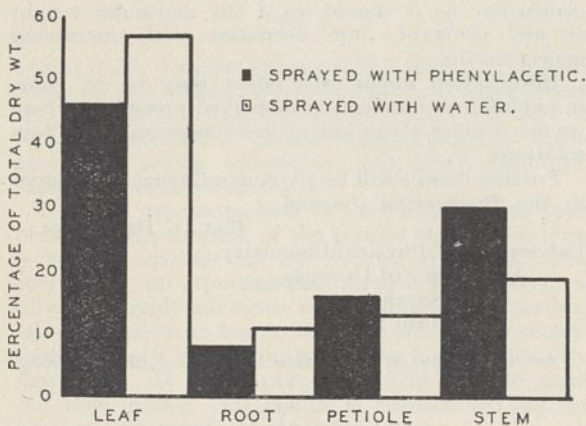


FIG. 2. Diagram showing the percentage of the dry weight present as stem, petiole, root and leaf after one week.

After one week the treated plants were more than thirty per cent taller than the controls, and the lengths of their petioles and internodes were also much greater. The diagram, Fig. 2, shows the percentage of the dry weight present as stem, petiole, root and leaf in the treated plants and the controls after one week.

From Fig. 2 it is seen that there are very significant alterations in the relative amounts of the various organs which make up the total dry weight of the plant. Thus the percentages of the total dry weight which are present as leaf and root have decreased, while the percentages present as stem and petiole have increased. These differences were maintained with little alteration after two and three weeks treatment. The water content of the treated plants had also increased indicating a more succulent type of growth. The total dry weight of the treated plants had not increased, however, and it would therefore appear that the growth substances may act not by increasing the growth of the plant as a whole, but by effecting the balance between stem, root and leaf.

If the treated plants were kept in a humid atmosphere, roots emerged from the stem after twelve to fourteen days. The spray method of applying the growth substance may therefore prove to be a convenient way of treating cuttings.

H. L. PEARSE.

Research Institute of Plant Physiology,
Imperial College of Science and Technology,
South Kensington, S.W.7.
July 29.

¹ P. W. Zimmerman and Frank Wilcoxon, *Contrib. Boyce Thompson Inst.*, 7, 209 (1935).

² A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 7, 447 (1935).

³ A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 8, 63 (1936).

Structure of the Wall of *Valonia*

THE interesting röntgenographic studies of O. L. Sponsler¹ and of W. T. Astbury, T. C. Marwick and J. D. Bernal² on the cell-wall of the large one-celled alga of the genus *Valonia* have revived the interest in the older microscopic investigations by C. Correns³ on the structure of the cell-walls of *Algæ*, including also *Valonia*.

Correns proved that the wall of *Valonia* and of some other *Algæ* consists of a large number of lamellæ, each containing numerous parallel cellulose fibrillæ, which are placed spirally around the axis of the cell, which is more or less of a cylindrical shape. The fibrillæ of the various odd-numbered lamellæ are practically parallel, as are those of the even-numbered lamellæ—there occur deviations of a few degrees—but the direction of the winding of the spiral in the odd lamellæ is opposite to that in the even lamellæ. In the case of *V. ventriculosa*, Astbury found that the angle made by the two directions may vary from 80° to 60°; for some *Cladophora* species this approaches 90°, according to Correns.

Up to now any explanation of the method by which this remarkable structure has been brought about is lacking.

H. J. Denham⁴ has observed that the protoplasm stream in the cells of the pili on the stamens of *Tradescantia virginica* near the cell-wall often runs exactly parallel to the longitudinal or steeply spiral stripes of this wall. It follows from a remarkable study by P. Martens⁵ that these stripes do not occur, as Denham thought, on the inner surface of the wall, but on the cuticula which covers the outer side of the wall; the inner side of the thin cellulose layer, situated under the cuticula, is completely smooth. By studying the double refraction of the cellulose layer, and by means of swelling experiments, I have been able to prove that the rod-shaped cellulose crystallites in this

cellulose layer possess a 'static preference' for the transverse direction. The layer has therefore a micellar structure which sometimes is called 'Röhrenstruktur'. The protoplasm courses approximately perpendicular to the direction which is most preferred by the crystallites in the cell-wall.

From a series of other important investigations of P. Martens^{6,7} it follows that the markings on the cuticula very generally are indications of the tensions which occur therein by the active growth and the passive stretch of the cell-wall layer situated under the cuticula. The stripings on the cuticula of the pili of *Tradescantia* are really therefore the result of the fact that the cellulose layer lying underneath is most stretchable in the direction which is practically perpendicular to the one preferred by the crystallites. The relation referred to here between the direction of the greatest stretchability and the internal structure has been settled satisfactorily by R. Sonntag⁸, P. Jaccard and A. Frey⁹.

It may be assumed that the protoplasm lying directly against the inside of the cellulose layer, as a result of the stretching of that layer, is in a state of tension in the same sense as the cuticula, and that the protoplasm stream is directed by this tension along that layer. This explains the observation of Denham, which, through Martens' observations, had proved puzzling.

Various careful observations have been made by H. Crüger¹⁰, L. Dippel¹¹ and E. Strasburger¹², from which it appears that the secondary thickenings which are often deposited on the inner side against the primary wall layer (not, however, in the case of the pili of *Tradescantia*, where the wall remains primary) are formed in the protoplasm streaming along the wall, and in such a way that it looks as if the protoplasm along the wall changes into wall substance. I directed attention in 1927¹³ to the fact that the rod-shaped cellulose crystallites in such secondary thickenings are deposited in the direction of the protoplasm stream along the wall. The crystallites are probably arranged by the stream in the direction of the stream.

From the foregoing it will now be clear why, in numerous cell-walls, the direction of the crystallites in the secondary wall layer is more or less perpendicular to that in the primary layer. The direction of the crystallites in the secondary layer is hence determined by the direction of the greatest stretchability of the primary wall layer. In the case of a completely homogeneous wall structure the directions of the crystallites in the primary and in the secondary wall layer will therefore be exactly perpendicular to each other, but a priori deviations from this position may be expected.

The normal case appears to be that the secondary deposition begins after the stretchability of the primary wall has been greatly diminished, in such a way that after deposition has taken place, practically no stretch of the wall occurs. If one supposes, however, that after a secondary wall layer has been deposited the primary wall regains its stretchability by the intussusception of new cell-wall material, then the protoplasm near the wall will be subjected to a tension which is now perpendicular to the direction of the crystallites in the secondary layer. A tertiary layer will then be deposited, of which the crystallites are approximately perpendicular to those in the secondary. This process may repeat itself periodically, for example, by the strong passing increase each day of the turgor pressure in the cell, due to carbon

dioxide assimilation in daylight. If one considers further that by the growing together of the rod-shaped cellulose crystallites placed next to, and end-on-end with each other, fibrillæ may be formed, then one may realize that the remarkable structure of the cell-walls of *Valonia* and other Algæ may be the result of the above mentioned process.

Applying the above train of thought, this structure should be effected by a periodic repetition of a process of wall thickening very generally found.

G. VAN ITERSON, JUN.

Laboratory of Technical Botany,
University College of Technology,
Delft.
July.

¹ "Orientation of Cellulose Space Lattice in the Cell Wall", *Protoplasma*, 12, 241 (1931).

² "X-Ray Analysis of the Structure of the Wall of *Valonia ventriculosa*", *Proc. Roy. Soc. Lond.*, B, 109, 443 (1932).

³ "Zur Kenntnis der inneren Struktur einiger Algenmembranen", *Zimmerman's Beitr. Morph. Physiol. Pflanzenzelle*, 1, 260 (1893).

⁴ "The Structure of the Cotton Hair and its Botanical Aspects", *J. Text. Inst.*, 14, 85 (1923).

⁵ "Phénomènes cuticulaires et phénomènes osmotiques dans les poils staminaux de *Tradescantia*", *La Cellule*, 41, 17 (1932-33).

⁶ "Recherches sur la cuticule" (3), *Protoplasma*, 20, 483 (1934).

⁷ "Le relief cuticulaire et la différenciation épidermique des organes floraux", *La Cellule*, 43, 289 (1934).

⁸ "Die duktilen Pflanzenfasern, der Bau ihrer mechanischen Zellen und die etwaigen Ursachen der Duktilität", *Flora*, 59, 203 (1909).

⁹ P. Jaccard and A. Frey, "Einfluss von mechan. Beanspr. auf die Micellarstruktur u.s.w.", *Pringsh. Jahrb.*, 68, 844 (1928).

¹⁰ "Zur Entwicklungsgeschichte der Zellwand", *Bot. Z.*, 13, 601, 617 (1855).

¹¹ "Die Entstehung der wandständigen Protoplasmaströmchen in den Pflanzenzellen", *Abh. Naturf. Ges. Halle*, 10, 45 (1868).

¹² "Ueber den Bau und das Wachstum der Zellhäute", *Jena*, 1882.

¹³ "De wording van den plantaardigen celwand", *Chemisch Weekblad*, 24, 166 (1927).

Insect Coloration and Natural Selection

IN NATURE of August 8 there appear two letters on the subject of natural selection: one from my friend, Prof. H. E. Armstrong, and another from my friend, Prof. Hale Carpenter. Prof. Armstrong in his attack on "Natural Selection" quotes me. Prof. Carpenter in his reply thinks that Prof. Armstrong's objections are easily answered. At the risk of appearing tedious, I desire to make one more effort to bring home to Prof. Carpenter the insuperable objections which exist to the explanation of "mimicry" or any other biological phenomenon whatever from "natural selection".

By mimicry Prof. Carpenter means the theory that superficial resemblances between different groups of butterflies and similar resemblances between flies and beetles, etc., resemblances in colour or shape or attitude, have the function of enabling the weaker of the two to escape its enemies. Every part of an animal has some relation to its life, which is a constant reaction to its environment, but whether these resemblances really act in the way in which Prof. Carpenter supposes is an open question. Certainly one is not convinced by his *obiter dicta*. Each case requires a renewed and critical examination, which so far it has not received. I need only say that two of the most distinguished entomologists living, Dr. McAtee, of the U.S. Biological Survey, and Dr. B. P. Uvarov, who first elucidated the problem of the migratory locust, repudiate the "natural selection" explanation of mimicry. Worse than all is the statement by Bergh in his "Nomogenesis", that the only case on record of a species of butterfly being seriously decimated by birds is that of a Danaid—a supposedly distasteful species—in Ceylon.

Even if Prof. Carpenter were proved to be right, however, and these "mimicking" resemblances really did function in the way he supposes, "natural selection" would be incompetent to explain them. "Natural selection" in a sense is a truism; it merely asserts that an organism exists and maintains itself, which is sufficiently obvious. But what the theory covertly assumes is that random inheritable variations in all directions are constantly taking place by chance—and that is simply not true. All the experimental evidence obtained by testing this point has given the same answer, and it is surely unsafe to base any biological theory on an assumption which has proved to be false. But it may be answered that 'mutations' are inheritable. Mutations have now been artificially produced, and always by similar experiments. If the eggs or young embryos are exposed to noxious conditions, then a large number are killed; some survive and develop normally whilst there is a border group of what we may term the 'half-killed' which develop into mutations. All mutants compared with the type are defective in vigour and viability. Mohr, the great authority on *Drosophila*, has constructed a scale of mutations: the slight mutations produce a slight effect on viability, the more obvious ones a greater effect, the most obvious a semi-lethal effect. Moreover, if mutants can be restored to normal conditions, after a certain number of generations they revert to normal development, and the mutant appearance which Johannsen defined as a "superficial disturbance of the chromosomes" passes off. No mutation has ever given rise to a natural race.

We have definite evidence that insects, like other animals, react to changes in the environment by changes in growth and appearance, and that when these changes in the environment are long continued, their effects become so engrained in the constitution that they are in ever-increasing measure inherited by the offspring. This has been proved by Heslop Harrison for the egg-laying habits of *Pontania salicis*, by Durkheim for the coloration of Pierid pupæ, for feeding habits by Miss Sladden and, *mirabile dicta*, for the colour of the imago of butterflies by Weismann himself.

When fully documented evidence for evolution as displayed by a minute study of species and races of living forms or by the study of lineage series in fossils is carefully studied, this dependence of evolutionary change on change in habit and function becomes apparent. It is useless to demand miracles in the shape of supposedly beneficial mutations to explain changes where the full evidence is not at hand. When and if it is available, I am convinced that apparently inexplicable cases will yield to the same explanation of inherited habit as those cited above.

E. W. MACBRIDE.

West Bank,
Alton,
Hampshire.

The External Forces Acting on Chromosomes

ACCORDING to Darlington¹, in somatic mitosis or meiosis, "the equilibrium position reached at metaphase may . . . be described as the result of the combination of three kinds of repulsion acting on bodies in the confined space of the spindle", the repulsions being between chromosomes, between spindle attachments, and between poles and spindle

attachments. If therefore at the first metaphase of meiosis there should exist two kinds of bivalents the different shapes or sizes of which cause the spindle attachments of the component chromosomes to be farther apart in one kind than in the other, we should expect the former type of bivalent to be pushed to the edge of the plate.

In the plant *Silene Otites* Wibel, the chiasmata at first metaphase are all terminal or nearly so, and a mixture of rod bivalents with one chiasma and ring bivalents with two chiasmata is found, the spindle attachments being farther apart in the rod bivalents. The latter tend regularly to be arranged on the edge of the plate, a minor, but none the less striking, verification of the theory.

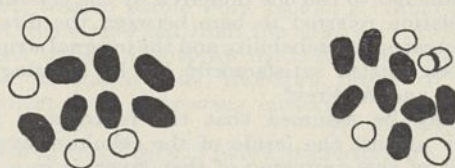


FIG. 1. Two polar views of the first metaphase of meiosis in pollen mother cells of *Silene Otites* Wibel. For the purpose of illustration the bivalents with one chiasma are shown in outline. ($\times 3000$ approx.).

In the polar views represented in Fig. 1 the bivalents with one chiasma can be distinguished by their smaller and more circular cross-section. The illustrations represent an apparent contradiction of the general rule that the largest chromosomes are found on the outside of the metaphase plate, but actually, as can be seen more clearly in side views, the difference is one of shape rather than of size.

JAMES L. FYFE.

School of Agriculture,
Cambridge.
July 16.

¹ C. D. Darlington, "Recent Advances in Cytology". J. & A. Churchill, London, 1932.

THE different distribution of rod and ring bivalents found by Mr. Fyfe in *Silene* is a clear and hitherto unnoticed example of the principle of repulsion-equilibrium in the formation of the metaphase plate. This effect evidently depends on the numbers of chromosomes, on the equality of their sizes combined with the variation in the number of their chiasmata, and on a certain size-relationship of chromosomes and spindle. Less conclusive evidence of the same distribution is to be found in my figures of *Primula sinensis*¹, *Campanula persicifolia* and diploid *Tradescantia*. In the last case the body-repulsions assist in producing the differential effect. Where the chromosomes are more numerous, as in *Aesculus*², the differential distribution is not clear without statistical treatment.

The detailed study of the congression and distribution of the bivalents on the plate in relation to their size and chiasma structure makes it possible now to describe the forces at work with more precision than a few years ago, especially in showing that the repulsions are an inverse function of distance³.

C. D. DARLINGTON.

John Innes Horticultural Institution,
London, S.W.19.

¹ *J. Genetics*, 24, 65 (1931).

² Upcott, *J. Genetics*; in the press.

³ MS. in the custody of the Royal Society (1935).

Provisional Computation of the Plane Vibration Frequencies of Symmetrical Deuteroethylenes

SEVERAL workers^{1,2} have developed the theory of the vibration spectrum of ethylene and have deduced from the experimental data values for some of the force constants occurring in the potential energy function of the molecule. A recent investigation by Bonner³ has improved our knowledge of the vibration spectrum of ethylene.

The most general potential function for plane deformations which is compatible with the admitted symmetry of that molecule contains 15 constants. On the other hand, as there are 9 plane normal modes, it seems at first that only 9 constants of force can be determined from the present data. However, in order to reach a precision in accord with the accuracy of some data (1 cm.⁻¹), 11 constants are necessary, owing to reality conditions to be satisfied. Such a numerical potential function has been calculated for ethylene from Bonner's experimental data and checked by recomputation of the vibration frequencies with less than 0.15 per cent error.

Assuming that the potential function is not altered when 'heavy' hydrogens are present in the molecule, the vibration spectrum of C₂D₄ was readily obtained. The spectrum of each of the three isomers C₂D₂H₂ was calculated from two secular equations, one of the fifth degree, the other of the fourth. Each of them results from coupling together two families of normal modes of different symmetries in the completely symmetrical molecule C₂X₄, in such a way that a mode of the isomer of lower symmetry is produced. The coupling occurs through the kinetic energy function only, which has a lesser symmetry for the isomeres than for C₂X₄.

	C ₂ H ₄	C ₂ D ₄	HDC : CDH <i>cis</i>	HDC : CDH <i>trans</i>	H ₂ C : CD ₂
1	S ₁ 1621.3	S ₁ 1428.8	π' 1516.5	S 1514.2	π 1555.3
2	3019.0	2283.9	3065.0	3049.2	3004.3
3	1343.9	1008.9	2304.2	2291.2	2221.0
4	A ₁ 2988.0	A ₁ 2152.5	1247.9	1240.2	1357.8
5	1444.0	1072.8	752.7	807.9	1043.1
6	S ₂ 3069.0	S ₂ 2308.0	σ' 3031.1	A 3053.2	σ 3088.1
7	950.0	758.3	2228.9	2233.4	2316.3
8	A ₂ 3107.0	A ₂ 2325.0	1295.4	1308.4	945.6
9	949.7	678.1	820.2	765.3	724.8

The horizontal lines separate the frequencies in different symmetry families. *S* and *A*, respectively, mean symmetric and antisymmetric with respect to the centre of the molecule. *S* frequencies are Raman active and infra-red inactive; the reverse is true for *A* frequencies. *π* and *σ* respectively mean symmetric and antisymmetric with respect to the carbon axis and *π'* and *σ'* the same with respect to the perpendicular axis in the plane of the molecule. They are all active in Raman effect and in infra-red absorption, but may be of widely different intensities. The *π* and *π'* frequencies are polarized and expected strong Raman lines, whereas the *σ* and *σ'* are depolarized and weaker. As is well known, for C₂H₄ and C₂D₄, *S* frequencies divide into two separate families S₁(*π π'*) and S₂(*σ σ'*) and also A₁(*π σ'*) and A₂(*π' σ*). The *π* frequencies show a marked *Q* branch in the infra-red absorption. The four fundamental symmetry families of the totally symmetric molecule combine in the following way to form the normal modes of the three isomers: *π'*(S₁A₂); *σ'*(S₂A₁); *π*(S₁A₁); *σ*(S₂A₂); S(S₁S₂); A(A₁A₂).

Owing to the uncertainty resting upon some data and also the neglect of the anharmonicity, no too close fit with the experiment can be hoped. However, it is expected that the obvious qualitative relationships existing between the spectra of heavy ethylenes will hold.

C. MANNEBACK.
A. VERLEYSEN.

Institute of Physics,
Louvain.
July 27.

- ¹ Sutherland and Dennison, *Proc. Roy. Soc., A*, **148**, 250 (1935).
² Delfosse, *Ann. Soc. Sci. Bruxelles*, B, **45**, 114 (1935).
³ Bonner, *J. Amer. Chem. Soc.*, **58**, 34 (1936).

Some Properties of Pentadeuterobenzoic Acid, C₆D₅COOH

THE acid was obtained by the reaction between pentadeuterophenyl magnesium bromide and carbon dioxide¹. The following details enable a comparison to be made between this acid and benzoic acid:

	C ₆ H ₅ COOH	C ₆ D ₅ COOH
Melting point:	121.7° C.	120.9° C.
Solubility in 100 c.c. water at 18° C.:	0.28 gm.	0.34 gm.
Molecular heat of combustion:	771400 cal.	761380 cal.
Dissociation constant at 25° C.:	6.6 × 10 ⁻⁴	6.6 × 10 ⁻⁴

A detailed account of this work will shortly appear in *Helvetica Chimica Acta*.

H. ERLÉNMEYER.
A. EPPRECHT.

Chemical Institute,
University of Basle.
July 29.

- ¹ Erlenmeyer, Lobeck und Epprecht, *Helv. Chim. Acta*, **19**, 793 (1936).

Nuclear Reactions due to Neutrons of 2 m.e.v. Energy

Most neutron workers hitherto have used Ra-Be, Ra-B or Ra-F as sources; these yield neutrons with continuous ranges of energies extending up to several m.e.v. The D-D nuclear reaction is considered to yield a homogeneous group of neutrons of about 2 m.e.v. energy. It is of interest, therefore, to know whether or not D-D neutrons can excite the nuclear reactions of the non-capture type reported by investigators using the radioactive sources.

We have been working in the Clarendon Laboratory with the neutrons obtained by bombarding heavy hydrogen with heavy hydrogen ions. The source of ions was a low-voltage arc of a modified Tuve and Dahl type. The total ion currents used have been of the order of 100 microamps. The accelerating voltage was 225 kv. Heavy phosphoric acid has proved to possess reasonably good lasting qualities as a target material. The yield of neutrons, as measured by the 2.3 min. induced activity of silver, has been checked at intervals over fifty hours' intermittent use, and has shown a constancy well within 10 per cent. Continuous runs of up to six hours' duration have been made.

With the exceptions of silicon and iron, the element under investigation was itself exposed to the 2 m.e.v. neutrons and then tested for induced radioactivity by means of a thin-walled Geiger-Müller counter. Silicon and iron were irradiated as SiO₂ and FeS respectively.

Silicon and phosphorus (half-periods, 2.5 min.) and phosphorus (half-period, 2.5 hr.) have been reported upon by Bjerger and Westcott¹. They found a measurable activity only in the case of the 2.5 hr. period of phosphorus.

We have bombarded the following elements with our 2 m.e.v. neutrons for times up to twenty minutes in order to test for the shorter period activities: manganese and chromium (half-period, 3.75 min.), aluminium (10 min.), zinc (5 min.), silicon (2.3 min.). Any activity induced was certainly less than 1 per cent of the activity-value for phosphorus (2.5 hr.) irradiated to saturation under the same conditions.

Exposures for times up to three hours were carried out on zinc (half-period, 6 hr.), iron (2.5 hr.) and nickel (20 min.). No activities were found greater than 2 per cent of the saturation phosphorus value.

Calcium (16 hr.), magnesium and aluminium (15 hr.) were irradiated for periods up to six hours. Here again, our counter showed no activity as high as 2 per cent of that of phosphorus.

Naturally, any of these reactions might yield a positive result with a stronger source of neutrons or, in the case of the long-period ones, with a longer period of irradiation. We are making alterations which should greatly increase the number of neutrons available. Further investigations will be made on the above and other elements.

E. T. BOOTH.
C. HURST.

The Clarendon Laboratory,
Oxford.

¹ NATURE, 134, 177 (1934).

Ultra-Violet Absorption Spectrum of Hæmoglobin

In a previous communication (Adams¹ *et al.*, 1934) it was shown that the ultra-violet band at 4100 Å., which is characteristic of hæmoglobin and its immediate derivatives, is not found in unclaked blood. This observation has been extended to several species and confirmed in all cases.

It has been found that the difference in physical state is not responsible for the absence of the band when the hæmoglobin is in the corpuscle. The cell volume was varied by placing the cells in solutions of different osmotic strength, but not more than 5 per cent variation in light absorption was observed. Precipitation of the hæmoglobin with a protective colloid gave a suspension of hæmoglobin with a density about equal to that of a blood corpuscle suspension. This preparation, although similar in physical properties to a cell suspension, displayed the same ultra-violet absorption spectrum as hæmoglobin in solution.

The explanation for the non-appearance of the band in the corpuscle was next sought in the possible combination of hæmoglobin with some constituent of the red blood cell to give a compound with no specific absorption at 4100 Å. Attempts to combine cholesterol, lecithin, glutathione and lipid extracts of the cells with hæmoglobin did not yield substances which lacked the band at 4100 Å. 'Stromatin', or stroma protein, was prepared by Jorpes' method² (1932). The pure protein does not exhibit any selective absorption in the 4000 Å. region. However, if a small percentage of hæmoglobin or methæmoglobin remained as an impurity in the preparation, the hæmoglobin band was absent.

This suggested a combination between hæmoglobin and stromatin to give a substance with no absorption

at 4000 Å. A small amount of pure stromatin was mixed with dilute hæmoglobin in alkaline solution. The spectrogram was taken at once, and at regular intervals for several hours afterwards. The mixture was kept at 37° C. The results show that, after heating at this temperature for 30 minutes, the ultra-violet band of hæmoglobin began to disappear, and at the end of one and a half hours there was no trace of selective absorption at 4100 Å. The experiment was controlled by treating hæmoglobin with the same amount of alkali in a similar way.

The results of these experiments lead to the conclusion that neither the crude lipids of the red blood cell, cholesterol, lecithin, or glutathione react with hæmoglobin in such a way as to change the specific absorption of hæmoglobin in the region of 4100–4200 Å. On the other hand, pure stromatin does react with hæmoglobin to cause the disappearance of its specific band at 4100–4200 Å.; and it is suggested that this same combination exists in the red blood cell, and is responsible for the lack of the specific absorption band in corpuscle hæmoglobin. Such an entity is apparently quite labile, since hæmolysis by a wide variety of agents causes the breakdown of the substance.

G. A. ADAMS.

Department of Biochemistry,
University of Western Ontario,
Medical School,
London, Canada.
July 25.

¹ G. A. Adams, R. C. Bradley and A. B. Macallum, *Biochem. J.*, 28, No. 2, 482–485 (1934)

² E. Jorpes, *Biochem. J.*, 26, No. 2, 1488 (1932).

Potassium in the Brain in Vitamin B₁ Deficiency

It has been stated that there is increased amount of potassium in the brains of pigeons suffering from vitamin B₁ deficiency. In view of the general interest attached to potassium salts and phenomena of excitation, I have re-examined this question. Unfortunately, I cannot find any significant difference between the amounts of potassium in the brains of normal and vitamin B₁ deficient pigeons, the values being 3.6 mgm. per gram of tissue in each case. The changes obtained by these authors¹ cannot, therefore, have been due to the avitaminosis.

HENRY W. KINNERSLEY.

Department of Biochemistry,
Oxford.
July 28.

¹ Ballif and Ghersevici, *C. R. Biologie*, 115, 75 (1934).

Kinetics of an Inverse Diene Synthesis in the Pure Liquid State

THE decomposition of dicyclopentadiene into cyclopentadiene is an inverse diene synthesis. It was found previously¹ that in paraffin solution the reaction is monomolecular and that the rate constant is given by $k = 6.0 \times 10^{12} e^{-34000/T}$ sec.⁻¹.

The rate of the decomposition has now been measured in the pure liquid state, using a method by which the cyclopentadiene was continuously removed from the reaction mixture. Measurements have been carried out between 100° and 155°, and within this range the Arrhenius equation is obeyed. The value

of the rate constant is $k = 3 \times 10^{13} e^{-35400/RT}$ sec.⁻¹, and the close agreement with the above figure shows that the mechanism of the inverse diene synthesis is the same both in solution and in the pure liquid state.

B. S. KHAMBATA,
ALBERT WASSERMANN.

University College,
London.

¹ NATURE, 137, 496 (1936).

THE formation of dicyclopentadiene from cyclopentadiene is a diene synthesis and the reaction is bimolecular in benzene¹ and in paraffin solution.

If rate measurements in the pure liquid state are carried out it has to be considered that the 'solvent' originally present (cyclopentadiene) is changed into a new solvent (mixture of cyclopentadiene and dicyclopentadiene). Hence it is not surprising that in each run a gradual change of the bimolecular rate constant (k) is observed. The constants characteristic of pure cyclopentadiene are obtained if the observed k values are extrapolated to zero time. Both the extrapolated

constants and those observed in benzene or paraffin solution obey the Arrhenius equation. The 'temperature independent factors' (Z) and the activation energies (E) are given in the accompanying table.

Reactants	Solvent	$Z^1/\text{gm.mol.sec.} \times 10^{-6}$	E kgm.cal.
cycloPentadiene	Benzene	1.2	16.4
cycloPentadiene	Paraffin	13	17.4
cycloPentadiene	cycloPentadiene	0.4 ²	16.1 ²

The accuracy of E is 5-10 per cent. It can be seen that the E 's agree within the limits of experimental error. Further, the Z values and hence the collision numbers between solute-solute molecules and between solute-solvent molecules are of the same order of magnitude.

ALBERT WASSERMANN.

University College,
London.

¹ NATURE, loc. cit.; *J. Chem. Soc.*, 1028 (1936).

² These values were calculated using unpublished measurements and the data given by Stobbe and Reuss, *Annalen*, 391, 151 (1901), Barret and Burrage, *J. Phys. Chem.*, 37, 1029 (1933) and Kistiakowsky and Mears, *J. Amer. Chem. Soc.*, 58, 1060 (1936).

Points from Foregoing Letters

THE use of contoured graphs for determining the configuration of atoms in crystals, from X-ray data, is explained and illustrated diagrammatically by Prof. W. L. Bragg. The analysis of atomic positions, it is claimed, can be more rapidly carried out with the graphs than by calculation.

The addition to serumalbumin solution of a protein (clupein) changes the sedimentation constant. The effect, according to Dr. K. O. Pedersen, is probably due to dissociation into molecules of perhaps one eighth the original size. This, the author considers, may be a general phenomenon which occurs with increasing concentration, even in solutions of a single protein, and may account for the abnormal increase in osmotic pressure with increased concentration of protein solutions.

A method of applying organic growth substances to plants by spraying is described by Dr. H. L. Pearce. Tomato plants sprayed with a dilute solution of phenylacetic acid showed increased growth in stem and petiole, with decreased growth in leaf and root.

Algae of the genus *Valonia* form very large bladder-shaped cells. By X-ray, microscopical and optical investigation of the wall, it may be shown that sub-microscopical rod-shaped cellulose crystals (crystallites) are present. The wall consists of about forty lamellae; in the odd-numbered lamellae all rods are parallel to each other, and in the even ones also, but in a direction which forms a large angle with the direction of the crystallites in the odd lamellae. Prof. G. van Iterson, jun., gives an explanation of the way in which this structure is developed.

In connexion with the discussion on the origin of mimicry in insects, Prof. E. W. MacBride disagrees with the view that random inheritable variations in all directions constantly take place by chance. He considers that animals react to changes in environment and, when these are long continued, their effects are increasingly inherited by the offspring.

Diagrams showing the position of chromosomes during the metaphase stage of the reduction division (meiosis) in pollen mother-cells of *Silene Otites* are submitted by J. L. Fyfe; they agree with the view of Dr. C. D. Darlington, that the configuration is determined by repulsion forces. Commenting on this communication, Dr. Darlington refers to additional evidence in support of his theory and states that the repulsions are inversely proportional to the distance.

A table giving the vibration spectra of several ethylenes containing heavy hydrogen (C_2D_4 and each of the three isomers $C_2D_3H_3$) is given by Prof. C. Manneback and A. Verleysen. The values were calculated from the known vibration spectrum of ordinary ethylene, by assuming that the 'potential function' is not altered when heavy hydrogens are present in the molecule.

The melting point, solubility, heat of combustion and dissociation constant of benzoic acid containing five heavy hydrogen atoms in the molecule are reported by Prof. H. Erlenmeyer and A. Epprecht.

No appreciable radioactivity has been observed by E. T. Booth and C. Hurst after irradiating, for periods varying from twenty minutes to six hours, substances containing various elements with neutrons of two million electron volts energy; these were obtained by bombarding heavy hydrogen with heavy hydrogen ions, using total ionic currents of 100 microamp. and an accelerating voltage of 225 kv.

Hæmoglobin as found in blood corpuscles differs from the prepared 'laked' variety in that it does not show an absorption band in the ultra-violet at 4100 Å. G. A. Adams, after investigating the effect of several substances, finds that the addition of stroma protein (stromatin) causes hæmoglobin to lose its absorption band at 4100 Å., and concludes that hæmoglobin occurs in blood in combination with stromatin.

Research Items

Marriage among Serbian Gypsies

IN continuation of his studies of the Serbian gypsies, Dr. Alexander Petrovič deals with marriage (*J. Gypsy Lore Soc.*, Ser. 3, 15, 3), drawing his material from Belgrade, Kragujevač and the neighbourhood of Arandjelovač, Rogatica, and Srebrnica. The gypsies from the two latter are Mahomedans, the remainder Orthodox. The marriage age is—Orthodox, boys, 13–18, girls, 12–16; Mahomedan, boys, 15–20, girls, 14–16. The later age among the Mahomedans is due to their custom of purchase, which involves a large sum. Neither bachelors nor old maids exist among the Christians, and to remain unwed is a disgrace. In olden times, marriages were celebrated at a much earlier age. The older generation used to betroth their children at 7–10 years and sometimes even before birth. In marriages in which the groom is very young, the bride usually being older by many years, it is customary for the father, or even grandfather, to be intimate with the bride in order to prevent her running away. These marriages secured a life-long bread-winner for the husband. Another reason given for early marriage is to ensure the descent in the male line and inheritance of the 'Slava' (patron saint) with the duty of celebrating his feast, as well as of burning candles in church for the parents after their death. The marriage is arranged by the father of the boy or the oldest man in the family. It is characteristic that when once a gypsy has decided on marriage, there is no delay. In marriage rites there is a tendency to imitate the customs of the neighbouring villages. Among some of the distinctive gypsy customs recorded is the pricking of a willow tree three times with a knife; while one of the chief marriage customs of all Serbian gypsies, but now no longer observed, was marriage around a tree. Even now, at Srebrnica, ties of marriage celebrated around a willow tree are considered more sacred than those celebrated by the 'Kadija'. In Mirijevo, the willow "symbolizes the woman". The rite of exposing evidence of virginity is widespread, as strict views are held on the subject of the virginity of the bride.

Tattooing in China

PROF. CHUNGSHEE H. LIU has initiated a historical survey of tattooing in China by a study of the practice as it still exists among the aboriginal Li people of the island of Hainan, southern China, which he contributes to the newly founded *Journal of Science*, published by the Sun Yatsen Institute for the Advancement of Culture and Education, Nanking. Tattooing is recorded under the Shang and Chou dynasties, when it was practised to avoid the trouble of dragons and snakes. No evidence for the custom can be traced among the 'Southern Barbarians' of the Middle Kingdom, where it might be expected. Among the Li, where it is called 'tatan' (cf. Polynesian 'tatu'), there are two traditions of its origin. According to one, it was a tradition of their ancestors that they might recognize their descendants easily; according to the other, when a mother and son were the only survivors of a great deluge, the former disguised herself by it from her son's recognition at God's bidding in order that the earth might be

repeopled. Tattooing is practised only by the women. The instruments used are a rattan needle and bamboo rod, with black ash, or Chinese ink. The designs are first drawn. The technique is not of a high standard, and is known to most old women. The designs may be divided into four groups: (1) oblique lines in twenty-seven forms, mostly used on the face; (2) horizontal lines in seventeen forms, mostly on the legs, but partly on the arms; (3) circular lines, twenty-five forms, mostly on the chin; and (4) linguistic forms, recorded only among the Pai-sha Li, and unintelligible. The practice may be interpreted as a system of tribal marking, as related to marriage, or the totemic idea, as a magic symbol, or as purely decorative. The custom is dying out, and should be studied further before complete extinction.

Respiratory Dust Disease in the Cotton Industry

COTTON spinners do not suffer more than operatives in many other dusty occupations from respiratory tuberculosis, bronchitis and pneumonia; but cotton 'strippers' suffer a bronchitis mortality more than double that in other dusty trades. These operatives remove the dust from the carding machines, which comb out the cotton fibres, producing much dust in the process. The cause of this excessive mortality from bronchitis among these hands has been investigated by Prof. Carl Prausnitz (formerly of Breslau) in Prof. Maitland's Department at the University of Manchester, and his conclusions are published in a Report to the Medical Research Council (Special Rep. Series, No. 212. London: H.M. Stationery Office, 1936. 2s. 6d. net). Chemical examination showed that three fractions may be extracted from the dust, a lipoid or waxy fraction with petroleum ether, histamine with alcohol, and protein with saline solution. The lipoid is apparently quite harmless, the histamine has also a doubtful role as a disease-producing agent, but the protein is definitely toxic, causing irritant effects and inflammatory lesions in the deeper tissues. It also causes a condition of allergic hyper-sensitiveness; this was demonstrated by animal experiments, and was found to be present in all diseased cotton operatives examined. Various treatments for mitigating the disease are suggested, but the leading principle consists in prevention. This may necessitate the provision and use of adequate respirators, for even powerful and properly directed ventilation fails to carry away the lightest and smallest particles of dust.

Seals in Cornwall

COMPLAINTS by fishermen in Cornwall regarding the damage caused to fisheries of mullet and herring by seals have led to a careful survey of the seal population by G. A. Steven (*J. Mar. Biol. Assoc.*, 20, 493; 1936). The only seal observed by him on the Cornish coasts was the grey seal, *Halichoerus grypus*, and its habit was to frequent, during the rest of the year as well as during the breeding season, caves which were inaccessible from the land side. During the survey (August 7–20, 1935) the numbers counted indicate a seal population on the north coast of not less than 300 and probably not more than 500; on the south coast the number, not estimated, is very

small. This differs very markedly from the estimate of 2,000 adhered to by the Cornwall Sea Fisheries Committee, and seems a much more trustworthy basis upon which to discuss any steps contemplated for the reduction of the seal population in the interests of the fishermen.

Larval Transplantation in Axolotl

KOLODZIEJSKI (*Bull. Internat. Acad. Polonaise*, Feb. 1936) reports the results of implanting axolotl larvæ upon hatching or within the first week or so in axolotls eight months old; all the implants were the offspring of the same parents. The skin of the back of the larvæ was cut, and they were inserted into holes in the dorsal fin of the host so that the tissues of the two animals could grow together. In some experiments the host skin grew over the implants, in others the implant fell off, but the majority fused successfully. The growth of the implants was fairly rapid at first, slowed down at four months and ceased altogether at six months, although some were kept alive for fifteen months. The internal organs of the implants developed more or less normally, but the external parts exhibited a wide range of abnormalities. Generally the body and tail were much reduced and the hind limbs entirely absent, while the fore limbs were often present and normally developed, and the head in some developed for several months. The reflexes and motility of the implant were independent of those of the host and were more developed where the body form more nearly approached the normal. Many implants had well-developed testes with motile spermatozoa, and while this condition was more common in those on male hosts it also occurred in those on female hosts. The lips of the cloaca were usually wide open, and in implants on male hosts the cloacal lips were markedly developed independently of the stage of maturity of their own gonads.

Morphology and Distribution of Penæids

MR. MARTIN D. BURKENROAD now concludes his preliminary review of the Penæidæ begun in two papers dealing chiefly with the littoral members of the family (1934 *a* and *b*) ("The Aristæinæ, Solenocerinæ and Pelagic Penæinæ of the Bingham Oceanic Collection. Material for a Revision of the Oceanic Penæidæ". *Bull. Bingham Oceanographic Coll.*, Peabody Museum of Natural History, Yale University, 5, 1936). The members of these sub-families are largely oceanic and of great interest in structure, habits and distribution. The question as to the relation between structural characters of penæids and their bathymetric habits is discussed and the distributional relations between the oceanic penæid faunas of the Atlantic and Pacific American regions. The larger part of the monograph of 151 pages is morphological, and the species are described and compared in great detail. The *Pawnee* third expedition collected a large number of species, four of which are new, but the descriptions are not confined to these, for there is also material from three co-operative cruises of the research ship *Atlantis*, sponsored jointly by Woods Hole Oceanographic Institution and by Yale University (Bingham Oceanographic Laboratory), and many more species are brought into the discussion dealing with the affinities of the various genera. Useful synopses of their main characters are given. All this very careful work is an important addition to our knowledge of this group of decapod crustaceans.

New Work on Cœlenterates

PROF. OSKAR CARLGRÉN has described a very interesting new Lucernariid from South Africa ("Ueber eine neue südafrikanische Lucernariide., *Depastromorpha africana* n.gen. n.sp., nebst bemerkungen über den bau und die systematik dieser tiergruppe". *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien. 15, No. 1; 1935). Besides the detailed anatomical description of *Depastromorpha*, the author has added a comparison of all known genera belonging to the Lucernariidæ with special reference to the musculature, and a table showing the relationships. This cœlenterate family occurs chiefly in northern and southern parts of the world, especially in the Arctic and Antarctic. Until 1933, only antarctic and sub-antarctic forms were known in the southern part of the Atlantic and Indian Oceans. In 1933, Dr. Carlgrén described a *Lipkea* from the coast of South Africa, and in 1935 Prof. T. A. Stephenson discovered in Kapstadt the species which is the subject of the above paper. Mrs. L. M. I. Macfadyen (Miss L. M. I. Dean) has described the Stolonifera, Alcyonacea, Telestacea and Gorgonacea of the Great Barrier Reef Expedition 1928-29 (Scientific Reports, 5, No. 2, British Museum (Natural History), 1936). The collection is a fine one, 51 species being described, of which 6 are new. The order Stolonifera includes several genera whose systematic position has caused discussion. Although agreeing with Prof. Hickson as to most of these, the author is of the opinion that *Solenopodium*, placed by him in the Stolonifera, is really a Gorgonacean. The reasons given are that it appears to be impossible to separate *Briareum* from *Solenopodium* as the spiculation is almost indistinguishable, and *Solenopodium* approaches towards the *Briareum* type of growth. It does not always show a creeping form of growth, but hollow stems grow upwards which are sometimes solid at the tops, forming as it were the beginning of a solid axis.

Brittle Stars from Puerto Rica

MR. H. CLARK has described four new species of brittle stars from the Puerto Rican Deep out of the collections made by the First Johnson-Smithsonian Deep-Sea Expedition (*Smithson. Misc. Coll.*, 91, No. 24. Johnson Fund. 1936). Among the numerous species obtained there are three new species of the genus *Ophiomusium*, two of which are interesting in having the upper of the two arm spines transformed into a hook curving outwards from the arm. There are eighteen specimens of *Ophiomusium regulare* n.sp., but only one each of the other two, *O. rosaceum* n.sp. and *O. alecto* n.sp. There is also a new species of *Ophiocira*, a genus of the family Ophiolucidæ, known heretofore only from the Philippine and Lesser Sunda Islands, from 220 fathoms.

Molluscs and Blood Flukes

ONE of the most widespread of the blood flukes infesting man is *Schistosoma japonicum*. Millions of the inhabitants of China, large numbers in Japan and smaller numbers in Formosa and the Philippines suffer from it. The intermediate host of this, as of many flukes, is a fresh-water mollusc. In spite of the considerable amount of work on the parasite and its relation to the primary host, little has been done on the intermediate host. Bartsch (*Smithsonian Miscell. Coll.*, 95, No. 5; 1936) has performed a useful piece

of work by reviewing very fully the known molluscan hosts. A number of them is fully described, and they are shown to belong to at least four distinct genera. A series of good keys is provided, which should be of assistance to future workers.

Self-Sterility in *Eruca sativa* Mill

THIS crop plant of the Punjab is highly self-sterile and is normally cross-pollinated by insect visits to the recently opened flowers. Mr. Z. Alam (*J. Genetics*, 32, No. 2) has made a genetical investigation of the self-sterility. Selfing reduces the length of pods by about one-third and the number of seeds to 2-3 per cent of that obtained from crossing. Plants raised from selfed seeds are weakly, shorter with fewer branches and pods, and give a lower yield of seed. Six plants were intercrossed in all possible ways. The results showed the existence of partially self-fertile as well as self-sterile plants. Some cross-matings were fairly sterile, and some compatible matings gave a much higher fertility than others. From bud pollinations it is concluded that a substance inhibiting pollen-tube growth is present in the style at anthesis, but is absent two days before and has gradually disappeared about two days after anthesis. Parthenocarp and phenospermy were also observed in these experiments. The cause of different degrees of cross-fertility requires further investigation.

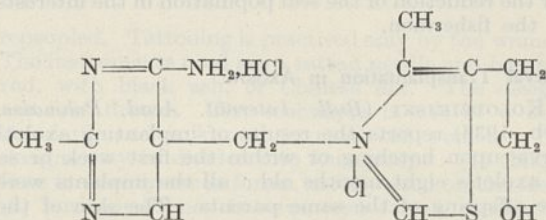
A Reagent for Structure Determination

IN the identification of organic compounds, those tests are especially valuable which can be carried out quickly on small amounts of material and show, by the formation of a colour or precipitate, the presence of a specific group or structure. R. Connor and J. H. Van Campen (*J. Amer. Chem. Soc.*, 58, 1131; 1936) describe a test which, under specified conditions, is general for substances which contain hydrogen on a carbon atom bearing at least one acyl group or two other activating groups. The test consists in adding an alcoholic solution of mercuric chloride to a solution of the unknown in alcohol containing sodium ethoxide. The formation of a white (occasionally cream coloured) precipitate is a positive test. The negative test is the formation of a deep yellow precipitate similar to that obtained when the sodium ethoxide and mercuric chloride solutions are mixed in the absence of an additional reactant. More than two hundred organic compounds have been tested with the reagent, and it appears that it is desirable to limit its use to neutral compounds which do not contain elements other than carbon, hydrogen and oxygen. The classes of compounds with which the test will be concerned will include ketones, aldehydes, esters, hydrocarbons, ethers, acetals, alcohols, quinones and anhydrides. Of these, the last five types fail to give a positive test. Aldehydes and ketones with hydrogen on the carbon atom bearing the carbonyl group give a positive test. The only esters which give a positive test are those which have both hydrogen and a labilizing group on the carbon atom bearing the carboxyl group. Acetylenes appear to give a positive test, and are the only hydrocarbons to do so.

Synthesis of Vitamin B₁

IN June last (*J. Amer. Chem. Soc.*, 58, 1063; 1936), Prof. Williams, of Columbia University, proposed a revised formula for vitamin B₁, in which 2,5-diethyl-

6-aminopyrimidine is linked through the 5-methyl group to the nitrogen atom of 4-methyl-5-β-hydroxyethylthiazole. According to this view, the vitamin is the hydrochloride of a quaternary nitrogen base:



The Columbia University workers have now, according to a more recent communication from Prof. Williams to the same journal (loc. cit., 58, 1504; 1936), isolated both the bromide and the chloride of a substance having the above formula, and have proved its chemical and physiological identity with the natural compound. The difficulties of their task may be imagined from the fact that the pyrimidine derivative was prepared by five stages from ethyl formate, acetamidine, $\text{NH}_2\text{C}(\text{CH}_3):\text{NH}$, and γ -ethoxyethylacetate, $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{COOC}_2\text{H}_5$. This was then combined with the substituted thiazole, and the resultant bromide as well as the chloride prepared from it were compared with the corresponding substances from yeast. The thiazole compound appears to be prepared by six stages from ethyl aceto-acetate, β -bromomethyl ether and thioformamide. Prof. Williams promises fuller details in forthcoming publications.

Dayload Peaks in Electrical Engineering Supply

IN the early days of electricity supply, it was soon realized that the machinery that had to be provided depended on the maximum (peak) load of the station. The higher the peak for a given load, the higher the price that had to be charged to the consumer. When direct current was used it was the custom to have a large battery of accumulators, which at times of light load were charged by the dynamos, and when the heavy load came they helped the dynamos by taking part of the load. Thus the load was equalized throughout the day. With alternating current supply it is more difficult to provide reserved power. In an article on "Dayload Peaks" published in the *Electrical Times* of August 13, it is stated that the time at which the peak load occurs is now in the process of changing from the evening to the morning. This is causing anxiety to those supply engineers who take a bulk supply, as their previous estimates will be upset and difficulties may arise. The following factors govern the times and nature of the daily peak load. One factor varies with the class of the load, which depends on the district, another on the time of the year, and a third on the weather. It has been noticed, for example, that the peak load occurs on a certain day at 5 p.m. A few days later, the weather being cold and foggy, it occurs at 9 a.m. This was due to the heating load from fires together with extra shop and domestic lighting. Except in large cities, there seems during the last two or three years to be a definite tendency for the maximum load to occur at breakfast time. If electric water heaters are used, and there is a large demand for hot water before breakfast, this in itself would be sufficient to cause a morning peak on the station load.

Twenty-five Years of Botanical Progress

THE Brooklyn Botanic Garden had the felicitous idea of marking the twenty-fifth anniversary of its foundation in part by the presentation and subsequent publication of a series of addresses dealing with progress in this period of time in different fields of botanical science. The series of addresses appears in vol. 4 of the *Memoirs of the Garden* (May 7, 1936), and will interest botanical readers everywhere.

The addresses were commendably brief, with the result that the most significant aspects in each field are usually thrown into prominent relief. Thus, Prof. C. E. Allen, dealing with cytology, after a brief reference to cytoplasmic structures, centrosomes and cell-wall, has a very penetrating analysis of the chief features of interest in chromosome studies in the twenty-five year period.

This pairs very well with Dr. Blakeslee's equally interesting review of the progress of genetics. Dr. Blakeslee finds that he is provided with about 0.7 seconds in which to discuss the twenty-five years work of each single geneticist, which produces the surmise that the so-called 'leaders of science' are rather 'pushed' than leading. "It is not the conspicuous spray which erodes the coastline of our continent but masses of water which surge forward with united front". Dr. Blakeslee regards us as passing, in 1910, from the Mendelism and 3 : 1 ratio period to that of "Brass Tacks—Genes and Chromosomes". The significance of three techniques are emphasized in this latter period; the aceto-carmin

method which has enabled the rapid study of the nuclei of large numbers of specimens, the production of mutation by radiation treatment and the analysis of chromosomal structure permitted by the salivary glands of fly larvæ.

Dr. Blakeslee decides that the last twenty-five years have brought us again to the species problem, and appropriately enough a contribution follows by Dr. Elmer D. Merrill, director of the New York Botanical Garden, who deals most temperately and justly with the species problem as seen by the experienced taxonomist.

Many other points of view are discussed in this entertaining volume; virus diseases are passed in review, the progress of ecological investigation, of forest administration and research, etc. In short, it is made clear that in the last twenty-five years progress in botany has passed beyond the grasp of any one individual. Let us hope that the result will be to make us all as reasonable in our demands as specialists as Dr. Merrill, who concludes that it is neither necessary nor desirable that all botanists should master the field of systematic botany. "Yet it can be maintained as a general truth that the individual investigator, no matter what his field, who has a reasonable knowledge of the names and relationships of the organisms with which he deals, is a better equipped individual for productive work within his own field, and that the teacher of botany who has the same knowledge is a better teacher".

Geology in Great Britain

PART 1 of the "Summary of Progress of the Geological Survey of Great Britain" for 1933¹ contains the usual annual reports of the Geological Survey Board and of the director and gives particulars of routine work carried out during the year under review. As in the succeeding year, there was some slowing down of normal activities on account of the immense amount of additional work involved in preparation for the transfer of the collections to the new museum at South Kensington. Nevertheless, thirty-nine maps were issued, together with five memoirs, which, with one exception, have already been noticed in our columns (*NATURE*, 134, 782; 1934); the remaining one, the Merthyr Tydfil memoir, is reviewed below.

The old Museum of Practical Geology in Jermyn Street closed its doors to the public at the end of 1933. Sir John Flett contributes an interesting outline of its history from its opening in the year of the Great Exhibition of 1851 (see also *NATURE*, 134, 129; 1934).

Part 2² contains a series of papers on subjects of special interest. M. Macgregor and J. Pringle discuss the Scottish Millstone Grit in relation to that of the Pennines. The freshwater fauna of the Lower Coal Measures of Lancashire is described and the range of variation of its constituents demonstrated by W. B. Wright. The corresponding fauna in West Yorkshire

is dealt with by D. A. Wray and A. E. Trueman. A valuable synopsis of Coal Measure plants and their stratigraphical distribution is provided by R. Crookall. The results of a study of the Carboniferous rocks of Innimore Bay, Morvern, on the Sound of Mull, are recorded by M. Macgregor and W. Manson. The fossils of certain pebbles in the Peel Sandstones of the Isle of Man are shown by H. P. Lewis to be of Salopian age. W. Manson describes the Carboniferous and Old Red Sandstone strata passed through by a boring for water (340 ft. deep) at Stonefold Farm, Berwickshire, with petrographical notes by J. Phemister. Sir John Flett continues his investigations of the teschenite-pierite sills of the Lothians with a study of a thomsonized inclusion from the Blackness sill.

Part 1 of the "Summary" for 1934³, in addition to the usual information, records the transfer of offices, library and collections from Jermyn Street to South Kensington. The opening of the new Museum in July 1935 was recorded, with an account of the centenary celebrations, in *NATURE* (136, 75; 1935). Despite the strenuous activity necessitated by the change-over, and the employment of the equivalent of about one third of the field staff in the preparation of exhibits, all the normal departments of the Survey's work were carried on without

serious interruption. Maps issued during 1934 number forty-one, and there were published two memoirs, both of which are reviewed below (Ardnamurchan model⁵ and Fife Coalfields, Area II⁶). Certain features of the year's work deserve special notice. The colour-printed maps include twelve of the London area on the six-inch scale; fifteen further sheets of the same series were in the press by the end of the year. Among new maps in progress, mention may be made of a series of economic maps of England and Wales on the scale of 16 miles to the inch. Two of the sheets, devoted respectively to the coalfields (exposed and concealed) and iron ores have since appeared. These indicate that the series is likely to be of great educational value, and teachers, in particular, should not overlook this authoritative guide to mineral resources. The most important innovation of the year, however, was the preparation of a series of eighteen descriptive handbooks under the general title of "British Regional Geology". Eleven of the handbooks have now been published and a separate account dealing with them will appear shortly in these columns.

In Part 2⁴, Prof. J. de Lapparent (Strasbourg) contributes a most important study of the Carboniferous bauxitic clays of Ayrshire. These deposits contain boehmite and diasporite and it is shown that the conditions of their formation involved the hydrolyzing action of a tropical climate followed by subsidence and burial. It is noted that bauxites which remained exposed during their formation contain gibbsite. W. Edwards describes the Pleistocene dreikanter of the Vale of York, and points out that conditions suitable for such wind-faceting were widespread in Britain and Europe towards the close of the Pleistocene. The strata encountered in a boring (810 ft.) in Northamptonshire are described by B. Smith, the special interest being the discovery of an old floor of presumably Pre-Cambrian quartzfelsite beneath the Keuper Marl. Another boring (980 ft.) at Bushey, Herts, reached Devonian rocks beneath the Gault. The strata are described by F. H. Edmunds; the Palaeozoic fossils by C. J. Stubblefield; and the underground water by F. K. Sinclair. One of the most widespread of the fossil-bands of the North-West Province of the Lower Carboniferous is that characterized by *Cyrtina septosa*. It has now been discovered in the Midland Province of Derbyshire and is the subject of a paper by F. W. Cope. Palaeontological contributions include a critical examination by K. P. Oakley of a Wenlock coral which has been referred to the Polyzoa by certain authors; a description of a Downtonian eurypterid from Lanarkshire by Dr. L. Störmer (Oslo); notes by C. J. Stubblefield on types and figured specimens acquired from the late S. S. Buckman by the Survey; and an account by W. B. Wright of the large species of *Carbonicola* which characterize the base of the Middle Coal Measures.

The "Guide to the Geological Model of Ardnamurchan"⁵ refers to a model, originally constructed for exhibition in the Royal Scottish Museum, which displays the complicated solid geology of the worn-down and long extinct volcano of Ardnamurchan. The horizontal scale is four inches to a mile, but as the highest peak, Ben Hiant, reaches only 1,729 ft., heights have been slightly accentuated by adopting a vertical scale of six inches to a mile. The guide is very fully illustrated and forms a readable introduction to the remarkably interesting features of a Tertiary volcano which is justly famous for the

perfection of its ring-structures and the variety and significance of its petrological phenomena. A detailed memoir on the area was published in 1930 (see NATURE, 128, 619; 1931).

The volume descriptive of the underground water supplies of Herefordshire⁶ is one of a growing series which now covers the London area and twenty-eight counties. The usefulness and practical value of these memoirs has been especially emphasized by the droughts of recent years. As Herefordshire is a county that depends to a very considerable extent on underground resources for its potable water—whether as feeders of bores, wells and springs, or as contributors to the flow of rivers during dry periods—this latest issue should prove especially welcome. The main rivers are also discussed as sources of supply, and a selection of chemical analyses of the river- and well-waters suffices to show the principal types of water available.

The first edition of the memoir dealing with the Merthyr Tydfil district of the South Wales Coalfield was published in 1904 and has been out of print for many years. The progress of mining and geological research has made necessary a considerable amount of revision in the new edition⁷, particularly as regards the zoning of the Carboniferous rocks and the underground structure and correlation of the coal seams. The district includes a large part of the magnificent mountain range of the Fforest Fawr, the highest peaks of which, the Brecknock Beacons, lie just north of the area described. Bare cliffs and numerous river channels clearly display the higher strata of the Old Red Sandstone, together with the Carboniferous Limestone and Millstone Grit formations. The southern part of the region is in Coal Measures and includes the industrial centres of Merthyr, Aberdare and the upper part of the Swansea valley. Special chapters are devoted to economic minerals and to palaeobotany.

The second of the series of memoirs describing the economic geology of the Fife coalfields⁸ deals with the central part of the county, comprising an area of about a hundred square miles, mainly occupied by strata of Lower Carboniferous age. The structure is complicated by numerous faults and intrusions of igneous rock, while the sequence in the southern part includes considerable thicknesses of lavas and ashes. The main structural feature is the Burntisland anticline, which separates the Cowdenbeath and Lochgelly coalfields on the west from the Kirkcaldy coalfield on the east. More than 1,400 bore and shaft records have been collected to elucidate the relations of the formations. Much of the memoir is devoted to the coal-bearing strata of the Limestone Coal Group and the Productive Coal Measures.

The memoir describing the geology of the Orkneys⁹ will be generally welcomed because the official survey has only recently been completed and is of special interest on account of the wealth of new information regarding the Old Red Sandstone now made available. The first four chapters deal with the history of geological research, the topography and scenery, and the general geology of the islands which make up the group. The intermediate chapters provide more detailed accounts of the individual districts and islands, while the last three chapters are respectively concerned with fossil fishes, fossil plants and petrography. With the exception of a small area in the neighbourhood of Stromness, where an ancient granite-schist complex occurs, most of the islands are mainly built of flagstones and sandstones belonging

to the Middle division of the Old Red Sandstone. These beds were folded and heavily eroded before the deposition of those of the Upper division. The latter are restricted to Hoy and include ashy sediments and olivine-basalt. Five volcanic vents have also been detected in Hoy. The structure of the island-group is comparatively simple, consisting essentially of a central series of synclines passing over on the west into the broad and gentle West Mainland anticline and on the east into a series of minor anticlines. Faulting follows three directions, two of which are represented by the shores of Scapa Flow, where three important faults all throw down towards the sea. Numerous dykes of bostonite, camptonite and monchiquite traverse the Old Red Sandstone, but their age, as elsewhere in Scotland where similar dykes occur, is still undetermined. The memoir is provided with a bibliography, a glossary of Orkney place-names, and an excellent geological map in colour on the scale of 4 miles to one inch.

¹ "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933". Part 1. Pp. viii+93. 1s. 6d. net.

² *ibid.*, Part 2. Pp. viii+108+8 plates. 3s. net.

³ *ibid.*, for the year 1934. Part 1. Pp. viii+85. 1s. 6d. net.

⁴ *ibid.*, Part 2. Pp. viii+65+4 plates. 1s. 6d. net.

⁵ Guide to the Geological Model of Ardnamurchan. By J. E. Richey. Pp. 49+9 plates. 1s. net.

⁶ Wells and Springs of Herefordshire. By L. Richardson. Pp. viii+136+2 plates. 3s. net.

⁷ The Geology of the South Wales Coalfield. Part V. Merthyr Tydfil. By A. Strahan, W. Gibson and T. C. Cantrill. Second edition. By T. Robertson; with a Palaeobotanical Chapter by R. Crookall. Pp. xix+283+6 plates. 5s. 6d. net.

⁸ Economic Geology of the Fife Coalfields. Area II. (Cowdenbeath and Central Fife). By J. K. Allan and J. Knox. Pp. xi+207+2 plates. 4s. net.

⁹ The Geology of the Orkneys. By G. V. Wilson and W. Edwards, R. C. B. Jones, J. Knox and J. V. Stephens; with Chapters on Fossil Fishes by D. M. S. Watson; Fossil Plants by W. H. Lang; and Petrography by J. S. Flett. Pp. xii+205+8 plates+a Geological Map (4 miles to 1 inch) in folder. 5s. net.

(London: H.M. Stationery Office.)

Educational Topics and Events

THE following scholarships for 1936 have recently been awarded by the Institution of Electrical Engineers: *Ferranti Scholarship* to W. E. Harper (University of Birmingham); *Duddell Scholarship* to P. Hargreaves (Lower School of John Lyon, Harrow); *Silvanus Thompson Scholarship* to L. S. Anand (North-Western Railway, India); *Swan Memorial Scholarship* to D. H. Thomas (Metropolitan-Vickers Electrical Co.); *David Hughes Scholarship* to W. H. Penley (University of Liverpool); *Salomons Scholarship* to E. F. O. Masters (City and Guilds College); *Thorrowgood Scholarship* to L. G. Leaton (Southern Railway Co.).

ARMSTRONG COLLEGE, Newcastle-upon-Tyne, has a Standing Committee for Research which distributed in 1934-35 grants amounting to £891. Its annual report, recently published, includes a series of informative notes by the recipients of these grants, which were in most cases for purchase of apparatus or material. The lion's share (23 out of 25) went to research in the natural sciences. One, made in connexion with a visit to the Massachusetts Institute of Technology for spectroscopic work, contributed to the establishment of valuable personal contacts with scientific workers in the United States. The visit included attendance at a conference on spectroscopy, an account of which was read before the British Association. Another grant was used largely in the purchase of Irish parliamentary reports for a study

of "British Imperial Policy in the Twentieth Century", which provokes the question: is it not 'up to' Governments, seeing that they stand to benefit from the products of competent disinterested research in the social sciences, to encourage it to the extent, at least, of placing such material gratuitously at the disposal of an investigator of the standing of a university professor of history.

THE Department of Business Administration at the London School of Economics, established a few years ago on the initiative of a group of business men for university men who were resolved on a business career, has had another successful year. An Advisory Council has recently been established to assist in maintaining the closest possible touch between training and current practice. The chairman of the Council is Major-General Guy P. Dawnay, and its membership includes Sir Harold Bellman, Sir Kenneth Lee, Sir Felix Pole, Sir Frank Spickernell and others who are prominent in different fields of finance, industry and trade and who are united in the determination to develop the Department as a centre of business training for graduates of British universities. Interest in the post-graduate course of business training extends beyond those industries represented on the Council, and an American business man has recently given £200 for a studentship for 1936-37 in the fields of investment or finance. The Leverhulme studentship of £200 is also open to competition. Some business firms have from time to time used the Department as a kind of staff college, and others have offered appointments to graduates subject to their first attending satisfactorily the Department's course. Great care is taken to admit to the course only those likely to make good in a business career. There is now apparent a demand among managers themselves for lectures on current problems, and in the winter months of 1936-37 a series of twelve such public lectures will be delivered by six members of the academic staff on matters of administrative organization, business finance, industrial production, distribution developments, marketing and public relations, statistical and accounting service.

A STUDY of education in Czechoslovakia was undertaken by the United States Office of Education two years ago. A report prepared by a specialist in comparative education, S. K. Turosienski, on the basis of visits paid to a great number of types of schools as well as interviews with school authorities and examination of official documents, has been published as Bulletin No. 11 of 1935 (Washington: Government Printing Office, 25 cents). The establishment of a national system of public education was one of the first tasks confronting President Masaryk after the new Republic of Czechoslovakia was constituted in November 1918. The report indicates that the system is working well and contributing powerfully to the prosperity and well-being of the nation. Problems arising from multilingualism—Czechoslovak, Carpatho-Russian, German, Magyar, Polish, Rumanian, modern Hebrew and other tongues are used as languages of instruction—have been solved with remarkable success. Religion is a compulsory subject of study in all elementary, secondary and normal schools, the time allotted for it being, in general, two hours a week. Particular care is taken to exclude influences calculated to inflame racial or national animosity. In all secondary and elementary schools instruction is given in civics,

under the headings: national culture, League of Nations, civilization of all nations, general progress of mankind, equality among the races and nationalities, the World Court, international treaties and guarantees, international pacifism, religious tolerance, history of labour and civilization, natural laws, man and the world, conditions of happy, peaceful life, etc. Parental co-operation with the school authorities is legally provided for by means of parents' councils. A noteworthy feature of the system is the clarity with which the objectives of education are set forth, not merely with reference to the educational process as a whole but also specifically for each course.

Science News a Century Ago

Death of Dr. William Henry, F.R.S.

ON September 2, 1836, Dr. William Henry, the eminent chemist, died at Manchester at the age of sixty-two years. The son of Thomas Henry (1734-1816), one of the founders and the first secretary of the Manchester Literary and Philosophical Society, he was born at Manchester on December 12, 1774, and attended the Manchester Grammar School. For several years he was secretary and assistant to Dr. Thomas Percival (1740-1804), the first president of the Literary and Philosophical Society, but, when twenty-one years of age, spent a session at the University of Edinburgh, where he was one of the last pupils of Black. On his return to Manchester, Henry assisted his father in his chemical business, wrote memoirs and lectured, and in 1801 published his "Epitome of Chemistry", which was enlarged and became "The Elements of Experimental Chemistry". It was said that this was the first English work on chemistry which with considerable literary merit combined scientific accuracy. It went through eleven editions. His experiments on the absorption of gases by water were made while he was writing these books. In 1805 he returned to Edinburgh, and two years later was granted the degree of M.D. The remainder of his life was spent in Manchester, where he counted among his friends Dalton.

Henry was elected fellow of the Royal Society in 1808, and in the same year received the Copley Medal. His original contributions to science included papers on medical subjects such as diabetes and cholera, and biographical sketches of Priestley, Davy and Wollaston. At intervals during his life he suffered severely from an accident received when a child, and his death on September 2, 1836, was due to nervous irritation and insomnia. He was a refined, eloquent and accomplished man, and his bust and portrait are preserved by the Manchester Literary and Philosophical Society of which he was an ardent supporter. His life was written by his son, Dr. W. C. Henry.

The British Association at Bristol

SUMMARIZING the results of the Bristol meeting of the British Association, the *Athenæum* of September 3, 1836, said: "Having now read the Reports; and calmly and dispassionately surveyed the entire proceedings, we are of opinion, that the results of the Bristol Meeting are most satisfactory: rather more than 1,300 members were present, many of the papers read were very valuable, many important questions

were discussed, and the Committee have been enabled to devote no less than £2,700, in further aid of science and scientific research. These are beneficial effects not to be questioned. It appears, however, that the Association does not work to the entire satisfaction of some influential members . . . who . . . are of opinion, that some proceedings in particular Sections had a taint of quackery . . . and they are in consequence disposed to limit the sphere of inquiry, or restrict the numbers. Now, we concur generally as to the possible tendency of the Association; such an opportunity for personal display and cheap advertisement will not be lost by the far-seeing; but the remedy suggested would be, in our opinion, a still more mischievous error. There can be no such thing as an oligarchy of science, which these restrictions would tend to create. We take leave to suggest the most scrupulous care in the election of Chairmen to the several Sections . . . and a great deal more energy and resolution on the part of the Sectional Committee; the one (the Committee) should be foreseeing and directing, and the other (the Chairman) the controlling mind of the Association. . . ."

Botanical Society of London

ON September 3, 1836, the *Mechanics' Magazine* said: "A number of botanists, amateurs, etc., have recently held several meetings at the Crown and Anchor Tavern, Strand, for the purpose of forming themselves into a society bearing the above name. . . . Among the leading objects the Society propose are, the advancement of botanical science in general; the particular cultivation of descriptive and systematic botany; the formation of a library, herbarium and museum; the reading of original papers, extracts and translations; the exchange of specimens with other societies or individual collectors; and every other available means that may promote the object of the Society". Commenting on this, the journal said: "We are glad to find, among the mighty mass of bricks and mortar; ladies and gentlemen so ardently devoted to so healthy and so enduring a pursuit as botany".

The Flora of Ireland

IN 1836 appeared the "Flora Hibernica: comprising the Flowering Plants, Ferns, etc., of Ireland; arranged according to the Natural System", by J. T. Mackay, who from 1806 until 1862 was curator of the Botanical Garden, Trinity College, Dublin. In a notice of the book in the *Athenæum* of September 3, 1836, a reviewer said: "We congratulate our Irish friends upon the publication of this work. It is most creditable to the naturalists of Ireland that the first general account of the plants of the island should appear in a form corresponding to the actual state of science elsewhere. . . ."

"The character of the classes and orders are taken chiefly from the writings of De Candolle and Lindley; and the arrangement employed by the last-mentioned botanist, in his 'Synopsis of the British Flora' is followed, with few exceptions. The character of the genera and species are chiefly from Hooker's 'British Flora'; for the matter relating to Mosses, Hepaticæ, and Lichens, the author is indebted to Dr. Taylor, and for the arrangement of the Algæ to Mr. W. H. Harvey, both of whom are naturalists well known for their acquaintance with those difficult groups."

Societies and Academies

Paris

Academy of Sciences, July 6 (*C.R.*, 203, pp. 1-136)*.

JACQUES ERRERA, POL MOLLET and Mlle. MARY L. SHERRILL: Tetramethylethylene and the influence of the double bond. Study of the infra-red spectrum.

VICTOR HENRI: The electronic state of the radicals in polyatomic molecules. The radicals discussed are SO, CN, C=C, NN, and NO. The results relating to the electronic states of the radicals, based on infra-red and Raman spectra, and on the determination of the distance between the atoms of the radicals measured by X-rays or electron rays, can serve as a basis for the analysis of the mechanism of chemical reactions between these molecules. They lead to a new interpretation of the laws of chemical kinetics.

MAURICE BACHELET: The extraction of uranium X by precipitation of ferric hydroxide. The exact working conditions are given: the yields vary from 85 to 95 per cent.

MAURICE E. NAHMAS and ROBERT J. WALLEN: Some artificial radio-elements. Results of the bombardment of fluorine and sodium by neutrons.

HANS VON HALBAN, JUN. and PIERRE PREISWERK: Experimental proof of the diffraction of neutrons.

GEORGES CARPÉNI: The dissociation constants of ascorbic acid and of its product of oxidation by iodine.

ALEXANDRE KRASSILCHIK: The use of the uranyl-magnesium reagent in dilute alcohol. Discussion of the errors inherent in this method of determining sodium, and suggestions for their elimination.

Mlle. JEANNE FORET: The synthesis of hydrated mono-calcium silicates under pressure.

TRYPHON KARANTASSIS and LÉANDRE CAPATOS: The hexa-iodotellurates of the aromatic amines and of the heterocyclic bases.

ADRIEN PERRET and JOSEPH BIECHLER: Researches on some chlorocarbonates.

Mlle. JEANNE BOULANGER: Study of the systems zirconyl oxalate, alkaline oxalates and water.

PIERRE SÛE: The thermal equilibrium between Nb_2O_5 , Na_2CO_3 , CO_2 .

GEORGES DUPONT and RAYMOND DULOU: The oxidation of cyclohexene by hydrogen peroxide.

JULES GARRIDO: The dehydration of brucite.

JEAN WYART and YEU KI-HENG: The crystallographic study of some derivatives of tartaric acid. X-ray studies of tartramide, tartramic acid, methyl tartrate and potassium borotartrate.

PIERRE MARIE: The Cretaceous micro-fauna of the south-east of the Paris basin.

MARCEL ROUBAULT: The radioactivity of some natural springs of the Kahylie de Collo (Department of Constantine, Algeria).

CHARLES BOIS: Earthquakes with abnormally deep focus. A table showing focal depth obtained by various authors by different methods.

PAUL CORSIN: The phylogeny of the Inversicatenales.

PAUL BERTRAND: Some fundamental observations for the comprehension of the organization of vascular plants.

ROGER HEIM: The phylogeny of the Lactario-Russula.

Mlle. JANE MANUEL: The sexuality of *Hansenuia Saturnus* and of some species of the genus *Saccharomyces*.

MARCELL MASCRÉ and RENÉ RAYMOND-PARIS: The comparative action of acrolein vapour on the cellular structure and glucidic composition of some plant tissues.

ANTOINE DE CUGNAC: The experimental production of inter-specific hybrids in the genus *Bromus*, and some related systematic considerations.

DÉSIRÉ LEROUX: The influence of the trituration of cultivated soils on the amount of essential fertilizing principles in their aqueous extract.

ROBERT CASTAGNÉ: The improvement of technique [historadiography]. Substitution of a window of lithium for one of aluminium. Lower voltages can be used and exposures shortened.

EMILE HAAS: Comparison between the energy of a simple radiation and that of a mixture of radiations of the same visual appearance.

CHARLES LAPICQUE: The optical structure of the vitreous body.

R. JONNARD: The interferential study of the refraction of blood serum as a function of the concentration.

STIG VEIBEL and ERIK NIELSEN: A case of a non-hydrolyzable β -glucoside.

JEAN ROCHE and Mlle. MARIE THÉRÈSE BÉNEVENT: The hæmatins of the α -cytochromes.

THÉOPHILE CAHN and JACQUES HOUGET: The utilization of glucides in experimental diabetes.

GASTON RAMON and ANDRÉ STAUB: A new method of anthrax vaccination.

Moscow

Academy of Sciences (*C.R.*, 2, No. 1, 1936).

S. MICHLIN: Composition of double integrals.

L. KANTOROVICH: Some theorems on semi-regular spaces of general type.

B. DEMIDOVICH: Existence of an integral invariant in a complex of periodic points.

P. A. WALTHER and V. A. STEFANOVSKIY: Action of centrifugal forces inside the axial pump.

A. A. GRÜNBERG and B. V. PTICYN: Titration of bivalent platinum and trivalent iridium at different temperatures.

J. G. RYSS and N. P. BAKINA: Complex fluorides. (1) Hydrolysis of the silicofluoride ion.

W. A. SILBERMINZ and A. K. RUSANOV: Occurrence of beryllium in fossil coals.

G. M. SMIRNOV and G. M. ZARIDZE: Neo-intrusions of the Dzryul crystalline massif.

A. M. LEBEDEV and L. I. SERGEJEV: Regeneration of vernalized plants after injury of the growing points.

I. N. KONOVALOV: The effect of the vernalization of plants upon the accumulation of organic substance.

S. V. DOROFJEV: Observations on the reproduction period of Greenland seals (*Histiophoca*) (*groenlandica oceanica* Lepechin).

A. S. SEREBROVSKIY: An attempt at a new method of genetical analysis of quantitative characters.

(*C.R.*, 2, No. 2, 1936).

P. S. ALEXANDROFF: Contribution to the theory of topological space.

B. Z. VULICH: Some remarks to the theory of K -normed space.

V. RASUMOVSKIY: Latent polarity and explicit polarity of molecules.

L. W. NIKITIN: Acoustico-electrochemical phenomena (2).

I. N. NAZAROV: Metal-ketyls of the fatty series. (4) Action of metallic sodium on *tert*-butyl-*tert*-amyl and *tert*-butyl-*tert*-hexyl ketones.

* Continued from p. 338.

T. N. GODNEV and S. V. KALISHEVICH: Quantitative determination of chlorophyll with the aid of the light of a Lange electrical colorimeter.

P. G. DANILCHENKO: Ecology of the spawning migrations of the salmon.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 327-434, June 15).

FREDERICK H. SEARES: Selective absorption of starlight by interstellar clouds. Measures of the colours of certain stars in luminous or dark nebulosities show them to be redder than would be expected from their spectral types. This seems to be due to selective absorption of light, and quantitatively it is sufficient to require a radical change in the estimated dimensions of the stellar system.

CECILIA PAYNE GAPOSCHKIN: On the physical condition of the super-novæ. Their spectra are similar to those of ordinary novæ, but with wider bright lines. It is concluded that they differ from novæ mainly in size, having possibly developed from giant stars.

E. S. CASTLE: A model imitating the origin of spiral wall structure in certain plant cells. Six wooden dowels are fixed in a wooden base and their free ends separated by a small wooden spool. A ring pushed down over the dowels produces a spirally twisted formation, which seems to be similar to that of the wall of the spore-bearing cells of *Phycomyces*.

NATHANIEL LYON GARDNER: A new red alga from New Zealand. It is parasitic on *Zostera* and has two forms, one having erect filaments (*Erythrocladia Hunteria*).

N. L. BOWEN and J. F. SCHAIRER: The system albite - fayalite. The mixture is heated in a crucible suspended in a platinum resistance furnace, and the temperature of appearance of a phase is determined by quenching the charge in mercury and examining it under the petrographic microscope to determine the phases present. The diagram for albite - fayalite is of simple eutectic type. It is hoped to use the marked fluxing action of albite to examine the equilibrium relations of other silicate mixtures.

M. DEMEREC: Frequency of 'cell-lethals' among lethals obtained at random in the X-chromosome of *Drosophila melanogaster*.

ALEŠ HRDLIČKA: Puberty in Eskimo girls. The age of onset for 16 full-blooded Kuskokwim Eskimos (Alaska) and also of 6 mixed-bloods is 13½ years, which is unexpectedly low for so far north.

FROELICH G. RAINEY: Eskimo chronology. A test cut to a depth of fourteen feet through a stratified midden deposit at Kukulik, St. Lawrence Island, Alaska, has revealed six cultural horizons, most of which have been recognized at widespread Eskimo sites in the Arctic.

WILLIAM HOVGGAARD: Torsion of rectangular tubes. Current theory, based on a hydrodynamical analogy, represents the angle of torsion correctly up to the point of breakdown, but gives an incorrect picture of the stress distribution.

R. COURANT: (1) On the problem of Plateau. (2) On the theory of conformal mapping.

G. A. MILLER: Regular subgroups of a transitive substitution group.

HANS LEWY: Generalized integrals and differential equations.

J. W. ALEXANDER: On the connectivity ring of a bicomplex space (2).

(To be continued.)

Forthcoming Events

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, August 29.—Annual General Meeting to be held at Newcastle-upon-Tyne.

Official Publications Received

Great Britain and Ireland

Survey of Thunderstorms in the British Islands. British Thunderstorms, continuing Summer Thunderstorms. Fourth Annual Report, 1934. (Vol. 2, Part 1.) By S. Morris Bower and others. Pp. iv+48+4 plates. (Huddersfield: Thunderstorm Census Organisation.) 2s. 6d. [48]

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Twenty-third Year) 1935, East Malling Research Station, East Malling, Kent, 1st January 1935 to 31st December 1935. (A. 19.) Pp. 242+10 plates. Free to Associate Members; to non-Members, 4s. Supplementary Annual Report (Twenty-third Year). General Development and Activities, East Malling Research Station, East Malling, Kent, 1st January 1935 to 31st December 1935. (Miscellaneous Publication H. 26.) Pp. 22. (East Malling: East Malling Research Station.) [48]

Prospectus of the University College of Wales, Aberystwyth. Sixty-fifth Session, 1936-1937. Pp. 128. (Aberystwyth: University College of Wales.) [78]

Other Countries

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme Terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 14. (Pp. ii+102. (Paris: Les Presses universitaires de France.) [78]

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 8 (Items 2842-2941): October, November, December, 1935. By Ernest A. Hodgson. Pp. 157-178. 25 cents. No. 9 (Items 2942-3041): January, February, March, 1936. By Ernest A. Hodgson. Pp. 179-194. 25 cents. (Ottawa: King's Printer.) [78]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 140: The Nature of the Deflection-Aileron Flutter of a Wing as revealed through its Vibrational Frequencies. By Katsutada Sezawa and Satoshi Kubo. Pp. 301-338+plates 4-7. (Tôkyô: Kôgyô Toshô Kabushiki Kaisha.) 50 sen. [108]

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen, 38: De gemiddelde hoogtewind boven De Bilt volgens loodsballonwaarnemingen. Door W. Bleeker. Pp. v+126. (s-Gravenhage: Rijksuitgeverij.) 1.10 fl. [108]

Proceedings of the First Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, held at Delhi from the 25th February to the 2nd March 1935; with Appendices. Pp. v+377. (Delhi: Manager of Publications.) 6 rupees; 9s. 9d. [108]

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 87, 1935. Pp. iii+572+17 plates. (Philadelphia: Academy of Natural Sciences.) 6.25 dollars. [108]

The Indian Central Cotton Committee. Spotted Boll-Worms in South Gujarat. Pp. 24. (Bombay: Indian Central Cotton Committee.) [108]

Indian Forest Records (New Series). Vol. 1, No. 3: Results obtained with a Timber Drying Kilm heated directly by Furnace Gases (Heimpel and Besler's Double Firing Generator Kilm). By Dr. S. N. Kapur. Pp. iii+77-92+2 plates. 10 annas; 1s. Vol. 2, No. 2: Standard and Commercial Volume Tables for *Dalbergia sissoo*. By M. A. Kakazai. Pp. iv+47-58+3 plates. 8 annas; 10d. (Delhi: Manager of Publications.) [108]

Memoirs of the India Meteorological Department. Vol. 26, Part 5: Soundings of Temperature and Humidity in the Field of a Tropical Cyclone and a Discussion of its Structure. By Dr. K. R. Ramanathan. Pp. 79-92+8 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2s. 3d. [108]

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1935. Erstattet von dem Direktor Dr. R. Schorr. Pp. 25+4 plates. Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 4, Nr. 8: Untersuchungen über die Methode der effektiven Wellenlängen. Von Marius Lobsien. Pp. 201-212. (Bergedorf: Hamburger Sternwarte.) [108]

U.S. Treasury Department: Public Health Service. Variations in Physique and Growth of Children in Different Geographic Regions of the United States. Physical Measurement Studies, No. 2. By Carroll E. Palmer and Selwyn D. Collins. (Reprint No. 1677 from the Public Health Reports.) Pp. 13. 5 cents. Height and Weight of Children of the Depression Poor. Health and Depression Studies, No. 2. By Dr. Carroll E. Palmer. (Reprint No. 1701 from the Public Health Reports.) Pp. 7. 5 cents. Changes in the Incidence and Fatality of Smallpox in Recent Decades. By Dr. A. W. Hedrich. (Reprint No. 1738 from the Public Health Reports.) Pp. 30. 5 cents. (Washington, D.C.: Government Printing Office.) [108]

Hamburger Sternwarte in Bergedorf. Bergedorfer Eigenbewegungs-Lexikon für die in der Bonner Durchmusterung, der Cordoba Durchmusterung und der Cape Photographic Durchmusterung, enthaltenen Sterne des nördlichen und südlichen Himmels. 2. Ausgabe. Unter Mitwirkung von Dr. W. Kruse und B. Irgart. Herausgegeben von Prof. Dr. Richard Schorr. Band 1: Nördlicher Sternhimmel. Pp. viii+410. Band 2: Südlicher Sternhimmel. Pp. viii+232. (Bergedorf: Hamburger Sternwarte.) [108]

The Academy of Natural Sciences of Philadelphia. Annual Review, 124th Year, 1935. Pp. 16. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [118]

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Agostini, Amodeo. Gli elementi d'Euclide e la critica antica e moderna. Libri XI-XIII. 8vo. Pp. 355. (Bologna: Nicola Zanichelli, 1936.) 30 lire.

Allen, Arthur B. Colour Harmony for Beginners: the Ostwald Theory. (Information Series.) Cr. 8vo. Pp. 63. (London and New York: Frederick Warne and Co., Ltd., 1936.) 1s. 6d. net.

Borchardt, W. G. A School Certificate Geometry. Cr. 8vo. Pp. vii+324+xxii. (London: Rivingtons, 1936.) 4s.

Brown, Frederick G. W. Mathematics for Technical Students. Part 1 (First Year Course). Imp. 16mo. Pp. x+215+xviii. (London: Macmillan and Co., Ltd., 1936.) 3s.*

Browne, H. F. Exercises in Algebra. Cr. 8vo. Part 1. Pp. 160. Part 2. Pp. 160. Part 3. Pp. 160. (London: Ginn and Co., Ltd., 1936.) 2s. each.

Carey, R. M. A School Algebra. Cr. 8vo. Part 1. Pp. vii+112. 1s. 9d. Part 2 (Short Form). Pp. vii+113-240. 1s. 9d. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.)

Catto, William S., and Williams, Frederick J. H. A Modern Elementary Trigonometry. Cr. 8vo. Pp. 263. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1936.) 3s. 6d.

Cazalas, Général E. A travers les hyperespaces magiques. Roy. 8vo. Pp. 20. (Bruxelles: Librairie du "Sphinx", 1936.) 2 belgas; 5 francs.*

Child, J. M. Ratio, Proportion and Similar Figures: a Supplementary Geometry. Cr. 8vo. Pp. iii+44. (London: Macmillan and Co., Ltd., 1936.) 1s.

Evans, W. A., and Harding, J. W. Revision Test Papers in School Certificate Mathematics (Arithmetic, Algebra, Geometry and Numerical Trigonometry). Cr. 8vo. Pp. vi+66. (London: Macmillan and Co., Ltd., 1936.) 1s. 6d.

Filshie, James H., and McIlroy, Robert D. The Straight Line and Circle. Cr. 8vo. Pp. v+153. (London and Glasgow: Grant Educational Co., Ltd., 1936.) 2s. 9d.

Flint, H. T. Geometrical Optics. Cr. 8vo. Pp. ix+266. (London: Methuen and Co., Ltd., 1936.) 7s. 6d.*

Godfrey, C. Woide, and Tait, R. C. B. A School Geometry. Cr. 8vo. Pp. viii+203. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 3s.

Heath, A. C., and Davis, H. Russell. Revision Algebra for School Certificate. Cr. 8vo. Pp. 71. (London: University of London Press, Ltd., 1936.) 1s. 3d.

Heussel, G. Elementare Elektrizitätslehre. 8vo. Teil 3: Das magnetische Feld. Pp. 231. (Berlin: Carl Heymanns Verlag, 1936.) 9.80 gold marks.

Hollmann, H. E. Physik und Technik der ultrakurzen Wellen. Band 1: Erzeugung ultrakurzweiliger Schwingungen. Med. 8vo. Pp. ix+326. (Berlin: Julius Springer, 1936.) 36 gold marks.*

Ingersoll, Leonard Rose, and Martin, Miles Jay. A Laboratory Manual of Experiments in Physics. Fourth edition. Ex. Cr. 8vo. Pp. ix+301. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 15s.*

Lenard, Ph. Deutsche Physik. In 4 Bänden. Sup. Roy. 8vo. Band 2. Pp. 271. (München: J. F. Lehmann, 1936.) 7.80 gold marks.

Lonsdale, Kathleen. Simplified Structure Factor and Electron Density Formulae for the 230 Space Groups of Mathematical Crystallography. (Published for the Royal Institution.) Demy 4to. Pp. vii+181. (London: G. Bell and Sons, Ltd., 1936.) 10s. net.*

McKenzie, A. E. E. Light. Cr. 8vo. Pp. x+178+10 plates. (Cambridge: At the University Press, 1936.) 2s. 6d.*

McMullin, D., and Parkinson, A. C. An Introduction to Engineering Mathematics. Cr. 8vo. Pp. viii+266. (Cambridge: At the University Press, 1936.) 4s.*

Mahajani, G. S. Lessons in Elementary Analysis. Second edition. Roy. 8vo. Pp. xii+264. (Poona: Aryabhushan Press, 1934.)*

Mises, Richard von. Wahrscheinlichkeit Statistik und Wahrheit: Einführung in die neue Wahrscheinlichkeitslehre und ihre Anwendung. (Schriften zur Wissenschaftlichen Weltfassung, herausgegeben von Philipp Frank und Moritz Schlick, Band 3.) Zweite, neubearbeitete Auflage. Demy 8vo. Pp. viii+282. (Berlin: Julius Springer, 1936.) 16 gold marks.*

Roberts, H. C. Intermediate Bookkeeping Exercises. Cr. 8vo. Pp. 128. (London: Edward Arnold and Co., 1936.) 1s. 6d.

Telling, H. G. The Rational Quartic Curve in Space of Three and Four Dimensions: being an Introduction to Rational Curves. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 34.) Demy 8vo. Pp. viii+78. (Cambridge: At the University Press, 1936.) 5s. net.*

Tornier, T. Wahrscheinlichkeitsrechnung und allgemeine Integrations Theorie. 8vo. Pp. vi+160. (Leipzig und Berlin: B. G. Teubner, 1936.) 9 gold marks.

Turner, Leonard. Examples in Practical Mathematics: Second Year (Senior) Course for Technical Colleges. Cr. 8vo. Pp. 96. (London: Edward Arnold and Co., 1936.) 1s. 6d.

Weber, E. Einführung in die Variations- und Erblichkeitsstatistik. 8vo. Pp. 255. (München: J. F. Lehmann, 1935.) 11 gold marks.

Whitby, S. L. A Course in Mathematics for Craftsmen. Part 1. Demy 8vo. Pp. 232. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 5s. net.

Engineering

Adams, D. R. Practical Aircraft Stress Analysis. Demy 8vo. Pp. viii+163. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 8s. 6d. net.

Anger, G. Zehnteilige Einflusslinien für durchlaufende Träger. 8vo. Pp. 88. (Berlin: Wilhelm Ernst und Sohn, 1936.) 8.20 gold marks.

Ardenne, Manfred von. Television Reception: Construction and Operation of a Cathode Ray Tube Receiver for the Reception of Ultra-Short Wave Television Broadcasting. Translated by O. S. Puckle. Demy 8vo. Pp. xv+121+43 plates. (London: Chapman and Hall, Ltd., 1936.) 10s. 6d. net.*

Caunter, C. F. Small Two-Stroke Aero Engines. (Aeronautical Engineering Series.) Demy 8vo. Pp. vi+81. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 6s. net.

Comité Consultatif International Téléphonique (C.C.I.F.). Proceedings of the Xth Plenary Meeting, Budapest, 3rd-10th September 1934. Translated into English by the Technical Staff of the International Standard Electric Corporation. Demy 4to. Pp. 660. (London: International Standard Electric Corporation, Ltd., 1936.) 25s. net.*

Den Hartog, J. P. Vibrations et mouvements vibratoires dans l'industrie mécanique moderne. Adapté par H.-L. Supper. 8vo. Pp. xii+418. (Paris: Libr. Dunod, 1936.) 95 francs.

Folwell, A. Prescott. Sewerage: the Designing, Constructing and Maintaining of Sewerage Plants and Sewerage Treatment Plants. Eleventh edition. Roy. 8vo. Pp. 412. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22s. 6d. net.

- Glasgow, R. S.** Principles of Radio Engineering. (Electrical Engineering Texts.) Med. 8vo. Pp. xii+520. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24s.*
- Hattingh, J. T.** A Universal Stress Sag Chart: for Power Line Computations. Med. 8vo. Pp. xii+74. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 12s. 6d. net.*
- Kearton, W. J.** Steam Turbine Operation. Second edition. Demy 8vo. Pp. xii+346. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 12s. 6d. net.
- Krey, H.** Erddruck, Erdwiderstand und Tragfähigkeit des Baugrundes. Fünfte Auflage, von J. Ehrenberg. Roy. 8vo. Pp. 347. (Berlin: Wilhelm Ernst und Sohn, 1936.) 23.50 gold marks.
- Loos, W.** Praktische Anwendung der Baugrunduntersuchungen bei Entwurf und Beurteilung von Erdbauten und Gründungen. Zweite unveränderte Auflage. Roy. 8vo. Pp. 148. (Berlin: Julius Springer, 1936.) 11 gold marks.
- Marston, Anson, and Agg, Thomas R.** Engineering Valuation. Med. 8vo. Pp. xiii+655. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.
- Mayer, M.** Betriebswissenschaft des Ingenieurbauwes. (Sammlung Götschen, Band 1097.) Pott 8vo. Pp. 158. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.) 1.62 gold marks.
- Schewior, G.** Die Wassermessung in Teichen, Flussläufen und Rohrleitungen. (Leitfäden zur Bodenkultur, Heft 8.) Roy. 8vo. Pp. 56. (Leipzig: Voigt Verlag, 1936.) 1.80 gold marks.
- Sowerby, A. L. M.** Foundations of Wireless. Cr. 8vo. Pp. xii+260. (London: Iliffe and Sons, Ltd., 1936.) 4s. 6d. net.*
- Spielmann, Percy Edwin, and Hughes, A. C.** Asphalt Roads. (Roadmakers' Library.) Med. 8vo. Pp. x+319. (London: Edward Arnold and Co., 1936.) 25s. net.
- Striepling, A.** Elemente des Stahlbaues. Zweite neubearbeitete Auflage, von C. Bülting. 8vo. Pp. 88. (Berlin: Wilhelm Ernst und Sohn, 1936.) 3.20 gold marks.
- Sublet, Frank G.** Electrical Engineering Materials, Tables and Properties. Roy. 8vo. Pp. 147. (Melbourne: Melbourne University Press; London: Oxford University Press, 1936.) 10s. 6d. net.
- Timoshenko, S.** Theory of Elastic Stability. Med. 8vo. Pp. xv+518. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36s.
- Lowry, T. M.** Historical Introduction to Chemistry. New edition. Cr. 8vo. Pp. xv+581. (London: Macmillan and Co., Ltd., 1936.) 10s. 6d. net.
- McKay, Robert J., and Worthington, Robert.** Corrosion Resistance of Metals and Alloys. (American Chemical Society Monograph Series, No. 71.) Med. 8vo. Pp. 492. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 35s. net.*
- Martin, Georges.** Blanchiment, teinture et impression. (Collection Armand Colin: Section de chimie, No. 194.) Fcap. 8vo. Pp. iv+217. (Paris: Armand Colin, 1936.) 10.50 francs.*
- Paarmann, S.** Chemie des Waffen- und Maschinenwesens. Roy. 8vo. Pp. 178. (Berlin: Julius Springer, 1936.) 7.50 gold marks.
- Peters, G.** Chemie und Toxikologie der Schädlingsbekämpfung. (Sammlung chemische und chemisch-technische Vorträge, Neue Folge, Heft 31.) Sup. Roy. 8vo. Pp. 120. (Stuttgart: Ferdinand Enke, 1936.) 9.20 gold marks.
- Poucher, William A.** Perfumes, Cosmetics and Soaps: with Especial Reference to Synthetics. Vol. 3: Being a Treatise on Modern Cosmetics. Fifth edition. Demy 8vo. Pp. xi+228. (London: Chapman and Hall, Ltd., 1936.) 21s. net.*
- Richter, Fr.** Kurze Anleitung zur Orientierung in Beilsteins Handbuch der organischen Chemie. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet unter Mitwirkung von Konrad Ilberg. Roy. 8vo. Pp. 23. (Berlin: Julius Springer, 1936.)
- Schultze, Karl.** Das Ausblühen der Salze. (Sonderausgabe aus den Kolloid-Beiheften, herausgegeben von Wo. Ostwald.) Roy. 8vo. Pp. iii+99. (Dresden und Leipzig: Theodor Steinkopff, 1936.) 4 gold marks.*
- Schuster, F.** Stadtgas-Entgiftung. (Chemie und Technik der Gegenwart, Band 14.) Roy. 8vo. Pp. 167. (Leipzig: S. Hirzel, 1935.) 7.60 gold marks.
- Smith, Sylvanus J.** A Text-Book of Physical Chemistry. Ex. Cr. 8vo. Pp. xii+355. (London: Macmillan and Co., Ltd., 1936.) 5s. 6d.*
- Strebinger, R.** Praktikum der quantitativen chemischen Analyse. Teil I: Gewichtsanalyse, Elektroanalyse, Gasanalyse. Pp. vii+100. (Leipzig und Wien: Franz Deuticke, 1936.) 2.80 gold marks.
- Thompson, Daniel V.** The Materials of Medieval Painting. Demy 8vo. Pp. 239. (London: George Allen and Unwin, Ltd., 1936.) 7s. 6d. net.*
- Volk, R., und Winter, F.,** Herausgegeben von. Lexikon der kosmetischen Praxis. Pp. 705. (Wien und Berlin: Julius Springer, 1936.) 75 gold marks.
- Webb, T. J.** Elementary Principles in Physical Chemistry: with Special Reference to the State of Equilibrium in a Chemical Reaction and to the Rate of Attainment of the State of Equilibrium. (Century Chemistry Series.) Med. 8vo. Pp. x+344. (New York and London: D. Appleton-Century Co., Inc., 1936.) 16s. net.
- West, Clarence J.,** Edited by. Annual Survey of American Chemistry. Vol. 10, 1935. (Published for the National Research Council.) Demy 8vo. Pp. 487. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 25s. net.*

Chemistry: Chemical Industry

- Audibert, Étienne.** Les carburants. Première partie: L'Essence. Fcap. 4to. Pp. vi+181. (Paris: Gauthier-Villars, 1936.) 45 francs.*
- Bennett, H.** Practical Everyday Chemistry: How to Make what you Use. Med. 8vo. Pp. 305. (London: E. and F. N. Spon, Ltd., 1936.) 10s. net.
- Coke Oven Managers' Association.** The History of Coke Making and of the Coke Oven Managers' Association. (Issued by the Coke Oven Managers' Association to commemorate its coming-of-age, 1936.) 8vo. Pp. vii+139. (Cambridge: W. Heffer and Sons, Ltd., 1936.) 5s.
- Dupont, G.** Cours de chimie industrielle. Tome 3: Métallurgie. Roy. 8vo. Pp. iv+357. (Paris: Gauthier-Villars, 1936.) 65 francs.*
- Gmelins Handbuch der anorganischen Chemie.** Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Sup. Roy. 8vo. System-Nummer 4: Stickstoff. Lieferung 4. Pp. 855-1038. 25.15 gold marks. System-Nummer 23: Ammonium. Lieferung 1. Pp. 242. 28.10 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1936.)*
- Holderness, A., and Lambert, J.** School Certificate Chemistry. Demy 8vo. Pp. x+414. (London: William Heinemann, Ltd., 1936.) 4s. 6d.*
- Klar, M.** Fabrikation von absolutem Alkohol zwecks Verwendung als Zusatzmittel zu Motor-Treibstoffen. (Monographien über chemisch-technische Fabrikationsmethoden, Band 57.) Roy. 8vo. Pp. 84. (Halle a.S.: Wilhelm Knapp, 1936.) 5.60 gold marks.
- Braschler, E.** Die Festigkeit von Baumwollgespinnsten. Roy. 8vo. Pp. 175. (Zürich: Leemann Verlag, 1936.) 7.50 gold marks.
- Campbell, Harry L.** Metal Castings. Med. 8vo. Pp. ix+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 15s. net.*
- Denny, Grace G.** Fabrics: Definitions of Fabrics, Practical Textile Tests, Classification of Fabrics. Fourth edition, revised and edited by B. R. Andrews. Ex. Cr. 8vo. Pp. 178. (Philadelphia and London: J. B. Lippincott Co., 1936.) 9s. net.
- Epstein, Samuel.** The Alloys of Iron and Carbon. (Alloys of Iron Research Monograph Series.) Vol. 1: Constitution. (Published for the Engineering Foundation.) Med. 8vo. Pp. xii+476. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 30s.*

Technology

- Fuss, V.** Metallography of Aluminium and its Alloys. Translated from the German by R. J. Anderson. Roy. 8vo. Pp. xiv + 424. (London: Chapman and Hall, Ltd., 1936.) 42s. net.
- Grimwood, Herbert H., and Goodyear, Frederick.** An Introduction to Decorative Woodwork: for the Use of Schools. Cr. 4to. Pp. xv + 239. (London: University of London Press, Ltd., 1936.) 20s. net.
- Grover, Frank.** Practical Fur Cutting and Furriery. Sup. Roy. 8vo. Pp. viii + 127. (London: The Technical Press, Ltd., 1936.) 21s. net.
- Haas, H.** Beitrag zur Kenntnis der Einwirkung der Wärme auf die Baumwolle. 8vo. Pp. 78 + 2 plates. (Würzburg: Konrad Tritsch, 1936.) 3 gold marks.
- Hebberling, H.** Das Wichtigste vom Korrosionsschutz. 8vo. Pp. 45. (München: Georg D. W. Callwey, 1936.) 2 gold marks.
- Holz, A.** Die Schule des Elektrotechnikers: Lehrbuch der angewandten Elektrizitätslehre. Dritte vollständig neubearbeitete Auflage. 8vo. Pp. 272. (Leipzig: Schäfer Verlag, 1935.) 8 gold marks.
- "Jay."** Camera Conversations. Imp. 8vo. Pp. xvi + 300 (120 plates.) (Toronto: The Macmillan Co. of Canada, Ltd., 1936.) 21s. net.
- Main, W., et Chaplet, A.** Toutes les matières plastiques artificielles (celluloïds, bakélites, pollopas, galalite, ébonite, papier mâché, etc.) 8vo. Pp. 240. (Paris: Desforges et Cie., 1936.) 30 francs.
- Rabone, Philip.** Flotation Plant Practice. Second edition, revised and enlarged. Med. 8vo. Pp. xv + 165. (London: Mining Publications, Ltd., 1936.) 10s. 6d.*
- Richmond, L., and Littlejohns, J.** The Art of Painting in Pastel. Demy 4to. Pp. 187 + 39 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 10s. 6d. net.
- Richmond, L., and Littlejohns, J.** The Technique of Pastel Painting. Demy 4to. Pp. viii + 144. (London: Sir Isaac Pitman and Sons, Ltd., 1936.) 10s. 6d. net.
- Scherer, K.** Das Ziehen von Pappe. 8vo. Pp. 64. (Berlin: Papier-Zeitung, 1935.) 1.50 gold marks.
- Schilde, E.** Die keramische Industrie in Sachsen. (Dresdner geogr. Studien, Heft 10.) Roy. 8vo. Pp. 104. (Dresden: von Zahn und Jaensch, 1936.) 3 gold marks.
- Smith, Percy J.** Lettering: a Handbook of Modern Alphabets. Gl. 4to. Pp. xii + 100. (London: A. and C. Black, Ltd., 1936.) 10s. 6d. net.
- Staudacher, E.** Der Baustoff Holz. Roy. 8vo. Pp. 109. (Zürich: Leemann Verlag, 1936.) 5.60 gold marks.
- Stevenson, J. A. R.** The Din of a Smithy. Passages selected and arranged by A. F. Collins. (The Craftsman Series.) Cr. 8vo. Pp. viii + 112 + 4 plates. (Cambridge: At the University Press, 1936.) 3s. 6d.
- Stuart, A. F., and Crisp, Quentin.** Lettering for Brush and Pen. (Information Series.) Cr. 8vo. Pp. 47. (London and New York: Frederick Warne and Co., Ltd., 1936.) 1s. 6d. net.
- Wierz, M.** Die Warmwasserheizung. Roy. 8vo. Pp. 130 + 8 plates. (München und Berlin: R. Oldenbourg, 1936.) 6.60 gold marks.
- Islands.** By Lieut.-Col. E. A. Glennie. Pp. 95-108 + 1 plate + 4 charts. 2s. 6d. Vol. 1, No. 5: An Account of Horsburgh or Goifurfehendu Atoll. By Lieut.-Col. R. B. Seymour Sewell. Pp. 109-126 + 6 plates. 2s. 6d. (London: British Museum (Natural History), 1936.)*
- British Museum (Natural History).** Great Barrier Reef Expedition, 1928-29. Scientific Reports, Vol. 5, No. 3: Copepoda. By G. P. Farran. Roy. 4to. Pp. 73-142. (London: British Museum (Natural History), 1936.) 5s.*
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