NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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A WORLD AUXILIARY LANGUAGE

IT has been well said that all men desire peace but very few desire those things which make for peace. Among "those things" must be placed an international auxiliary language which, though of almost hoary antiquity, has never interested more than a fraction of civilized mankind. The reasons for this apathy are many, but among the chief are : the imbalance between the self-assertive and combative instincts and the gregarious and co-operative instincts ; mental sloth ; patriotic bias ; and the obduracy shown by innovators in resisting reforms.

Civilized nations have already adopted common signs and code languages for use in mathematics and science, music, marine flag-signalling and wireless messages. No one would suggest to-day that people of differing nationality should employ different languages for such purposes, and thus it is that musicians can play from scores produced by other nationals. Ships' officers can send messages of considerable length and complexity by means of Morse and other signals. All nations understand the same numerals, the same chemical, mathematical and other technical signs. But, when the users of these convenient inventions wish to communicate by word of mouth or in writing, they are often unable to do so unless they happen to understand the same language. Is it not time that this state of affairs was abolished, and international intercourse put on a basis of facility and fluency ? The modern world is, indeed, somewhat behind the Middle Ages, when a sort of conversational Latin provided a means of direct communication between educated people. Despite Hegel's dictum that history teaches only that history teaches nothing, it seems more than likely that when the present War ends we shall see a strengthening of democratic ties and tendencies and a revival of the international language problem, just as we did after the War of 1914–18. The subject has already been raised by Sir Richard Gregory (NATURE, **150**, 622 ; 1942), in the report of the British Association Committee on Post-War University Education (NATURE, **150**, 716 ; 1942) and elsewhere.

The history of the movement is too long to justify more than a passing notice of a few of its salient features. The first recorded attempt to construct a world language was made some six hundred years ago by the Abbess Hildegarde, of Rupertberg, near Bingen. She devised a system with an alphabet of thirty-two letters on lines which did not appear again until the latter part of the nineteenth century. Then followed Descartes, in 1629, who elaborated a series of conditions which any universal language must satisfy. He had in mind a philosophical language not linked to natural languages ; and this was also the conception of Leibniz, who invented a system of classifying ideas into main groups and sub-divisions, using numerals allied with nine consonants and five vowels as symbols, and thus in a measure anticipating the modern Dewey system of library classification. Leibniz also appears to have been the first to foresee the possibility of a synthetic language constructed from word-roots in natural languages. In 1795, the

third year of the French Revolution, Delormel presented to the National Convention a project based on the decimal system, which aimed at "uniting the peoples by the delicate bonds of brotherhood" through the medium of a common logical and regular language, because "national languages present at each step irregularities which make them difficult and demand a long time to learn". Coming to more modern times, in the 1880's, J. M. Schleyer, a Roman Catholic priest, succeeded in constructing a new language, Volapük, by building it up from the roots of words in existing languages, but after some progress the effort failed because the grammar was very involved; it was very difficult to identify the distorted monosyllabic roots, and the inventor refused to countenance any attempt at reform.

In 1887 appeared a much simpler and more flexible language, Esperanto, which has lasted much longer and attained far more success than any of its predecessors. Esperanto derives its vocabulary almost entirely from Western languages, its grammar is very simple, its pronunciation euphonious, and it lends itself easily to the introduction of new words. There may be certain defects in it, such as the arbitrary choice of roots from existing languages, which makes Esperanto easier to read than to speak, but experience has shown that it is perfectly practicable: people attending Esperanto congresses from all parts of the world, and meeting for the first time, converse fluently in it. Propaganda has now been conducted systematically and intensively for about fifty years, and on the whole has not been seriously prejudiced by the efforts of rival bodies, like those professing Ido, Esperantido and Occidental. The number of people who speak Esperanto is estimated at 1½–2 millions, though there are no reliable statistical data on the subject.

In 1919 the International Research Council recommended the appointment of an international committee to investigate the question, and in the same year the British Association appointed the committee which, in 1921, reported in favour of a neutral synthetic language. In 1920 the subject was discussed at the General Congress of the World Union of International Associations, and a resolution in favour of Esperanto was passed, with one dissentient. In 1922 a report was presented to the Third Assembly of the League of Nations, which was in general agreement with the findings of the British Association Committee, except that it declared outright in favour of Esperanto. A Red Cross conference, held in 1921, also voted for Esperanto, and in November of that year the conference of the International Labour Office recommended to the administrative council of the International Labour Office that it should increasingly use Esperanto as a practical means for facilitating international relations. Governmental recognition and help has been accorded by Spain, Portugal, Bulgaria, Czechoslovakia, Germany, Austria, Finland, Brazil, China and Japan. In addition, numerous municipal, commercial and academic authorities have passed resolutions in its favour, and the Roman Catholic Church has on more than one occasion shown a friendly attitude. Among scientific bodies that have interested themselves in this language is the French Academy of Sciences, which in 1921 published a manifesto urging scientific workers to adopt it; it was signed by thirty-nine prominent members, including Berthelot, Lumière, Painlevé and the Prince of Monaco. But revolutions are not made by resolutions.

As an international language is essentially a democratic ideal, it is not surprising that when the Nazis came into power in 1933 they discountenanced the use of Esperanto; in fact, in 1936, Himmler issued a police decree ordering the dissolution of all international language societies in the Reich, and similar action was taken later in Austria and Czechoslovakia. When war came in 1939, international contacts were inevitably broken, but the ardent advocates of Esperanto have continued their efforts, though nothing has been heard of other language projects. The Army Education Service includes Esperanto among the subjects for postal study courses, and for several years past the Royal Society of Arts has held examinations in the language. It is, furthermore, taught in a number of schools, both primary and secondary, as a regular or optional subject.

As previously stated, the end of the present War may see a revival of interest in an international auxiliary language; if the outcome corresponds with our hopes, there will be a general resurgence of the democratic spirit, as opposed to the authoritarian, a greater recognition of the advantages of interdependence, and of the necessity for freer international trade and improved international communications. On the other hand, there is a danger that some of the liberated nations may be over-imbued with the spirit of nationality, that is, with patriotic bias, and will strive to maintain their independence, their institutions and their culture to a degree that will impair the spirit of mutual dependence (and especially if the proposal of federation does not fructify); but this impediment should not deter the adoption of a world language, if it be thoroughly understood that the language would in no case supplant an existing national language. A further impediment to realization would arise if any of the bigger nations were to insist on the general acceptance of its own national language. In the investigations made by the British Association Committee during 1919–21, it was found that with the exception of certain small countries in north-west Europe, commercial interests were all in favour of having their own national language adopted. This obstacle would be quite likely to arise among the Anglo-Saxon peoples, whose prestige and influence would be greatly enhanced by a successful war. The English language, with its obvious excellencies, is far too difficult for use as an international auxiliary language, and the general adoption of an easier but debased form of it would in the end debase the national language itself.

The problem, being essentially an international one, would best be handled by an international body, for example, a reformed League of Nations; but such a body would be effective only if it gained the

full support of its constituent members, and therefore, apart from private enterprise, individual governments would have to take steps to stimulate public interest in the question and eventually to canvass public opinion. Though the final decision as to the desirability of an international auxiliary language, and the language to be adopted, would rest with the international authority, each national representative should be in a position to declare unequivocally in favour of that chosen by his own country.

The problem, therefore, resembles nearly all other problems relating to human betterment, in being fundamentally an educational one. It would primarily concern governmental education departments, and these would be guided by an impartial commission consisting of representatives of all the main national activities : industry and commerce, science and its applications, letters and linguistics, schools and universities, and the great professions. Once an international auxiliary language had been chosen, the question of how and when it should be introduced would arise, and also whether or when instruction in it should be made obligatory. If the language were really simple, its introduction into primary and secondary schools should not lead to further congestion of the curricula. As a rule the very young learn readily to speak a new language, if they live in an atmosphere of it, but they forget it soon, and often completely, when they have no further use for it. A thorough knowledge of a new language is usually acquired very slowly by school children up to about sixteen or seventeen years of age, but after then, especially if they see the need for it and are given facilities for practising it, acquirement is much more speedy. There is, therefore, much to be said in favour of the proposal made by the British Association Committee on Post-War University Education that the learning of an international auxiliary language would best be undertaken as a long-vacation study in the university (and presumably in evening classes by non-university students). But no lasting progress or success would be attained unless adequate facilities were provided for using the language, whether in reading, correspondence, or conversation, preferably with foreign people.

Those whose faith in a war to end war has been rudely upset, and those who hold that man's combative instinct is neither eradicable nor transformable, may yet be convinced of the practical utility of an international auxiliary language in everyday life. Research workers would surely welcome a single journal containing all the abstracts of original papers and also copies of important papers they may need in one international language ; learned and technical societies could economize on the purchase of foreign literature ; and the use of an international auxiliary language at international scientific congresses would enhance not only mutual comprehension, but also the good-fellowship that has been so marked a feature of such gatherings in recent years. The end of the present War should provide a unique opportunity for translating into effective practice this six hundred year old ideal.

DYNAMICS OF THE STELLAR SYSTEM

Principles of Stellar Dynamics

By S. Chandrasekhar. (Astrophysical Monographs sponsored by the *Astrophysical Journal*.) Pp. x+251+6 plates. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1942.) 5 dollars.

As a subject progresses the attractive simplicity of the early researches gives place to laborious elaboration. In the last three years, Dr. Chandrasekhar has been very active in the mathematical development of stellar dynamics. The trend of his work may be judged from the fact that one contribution alone contains more than 1,800 numbered formulæ. There is no denying that this heavy method of attack can be justified ; but it leaves us with the depressing feeling that the subject which began thirty years ago as a joyous adventure has reached a stage of uninspiring ugliness. We are the more grateful to Chandrasekhar that in his new book he has not allowed the subject to be crushed by an overweight of mathematical formulæ. The treatment is, of course, mathematical throughout ; but it is mathematics of the methodological kind which the reader tolerates, not heavy algebra which he skips. The book fills an obvious gap in astronomical literature, and it should give a valuable stimulus to research. There are some omissions to which reference will be made later ; but, if judged by what it contains rather than by what it leaves out, it is a very helpful synthesis.

There are five sections, dealing respectively with stellar kinematics, the rate of approach to statistical equilibrium, the main problem of the dynamics of a galaxy, the theory of spiral structure in galaxies, and the dynamics of star clusters. The treatment is usually well arranged. I have, however, one complaint to make. The author follows the practice of continually introducing fresh symbols, and his final formulæ are left in whatever stage of symbolism he happens to have reached. Consequently his results are usually cryptograms, of which the key has been cut up into little pieces and hidden in odd corners. This may not incommode the systematic reader overmuch, but a reviewer can only judge the progress that has been made by the enunciations of the problems solved ; what the results amount to, and whether they reveal anything unexpected, he has no idea, since the author does not choose to tell him.

I shall here deal more particularly with the middle section on the dynamics of the galaxy, which is perhaps the most open to criticism. It seems to me to suffer from the lack of a defined practical aim, such as an observational result to be elucidated. The early development of galactic dynamics came about in a practical way. There were two rival views as to the nature of star-streaming—Kapteyn's hypothesis involving transverse streaming and Turner's involving radial streaming. Turner's hypothesis was less artificial, and the radial direction of streaming is now known to agree with observation ; but it raised difficult dynamical questions—whether the radial orbits would involve an impossibly high congestion of stars at the centre, or whether the data would demand too eccentric a position of the sun. Even if no new questions suggest themselves to-day, the bearing of galactic dynamics on these older problems might well have been treated, especially because

there has in the meantime been a great change in our knowledge of the dimensions and rotation of the galaxy. For example, Chandrasekhar rightly points out a fallacy in a theorem which I gave in 1915; and the correction makes the conclusion (that star-streaming in a steady system is necessarily radial) less general than has hitherto been supposed. But he does not take the opportunity of restating the position. Presumably it is still true that in a steady system with axial symmetry the velocity surfaces are confocal quadrics, and transverse star-streaming is rigorously excluded; but there is no mention of this. Again, later investigators have considered an expanding or contracting system especially with the view of explaining the apparent discordance between the vertex of star-streaming and the direction of the galactic centre; Chandrasekhar also admits a variation with time, but makes no reference to this question.

In galactic dynamics the stars are considered to move in the smoothed field of gravitational attraction of the system as a whole, the statistical effect of encounters being negligible. This formulation now seems so obvious that it may be forgotten that it was not the first stage of stellar dynamics. The fact is that the analogy between stars and the molecules of a gas was too enticing; and what was first looked for was an equipartition of energy. Misleading observational evidence of a correlation between masses and velocities of stars seemed to support this. The fallacious analogy might have endured much longer, but for the discovery of 'moving clusters' in which the stars have equal and parallel motions although they are widely separated in space. The most impressive of these is the Ursa Major cluster, which comprises stars in other parts of the sky, including Sirius. The realization that the time of relaxation to statistical equilibrium is extremely long (10^{14}–10^{16} years) was one factor in the change; another factor was the realization that the time of relaxation to dynamical equilibrium is remarkably short (10^{8}–10^{9} years). We were thus led to contemplate the stellar system as dynamically in a more or less steady state, changing very slowly towards the ultimate statistical equilibrium, or more strictly towards an ultimate collapse and dispersal. But the most important factor which led to the formulation of galactic dynamics was that urgent questions relating to the star-streams demanded such a theory.

The obvious problem is to determine the possible states of motion of a galactic system governed by its own gravitational field. So far as I am aware, no solutions have been found except for a distribution of density with spherical symmetry; but this soluble case, besides being rather attractive mathematically, helps us to gain a better understanding of the whole subject. Although the progress has not been very great, it is scarcely justifiable to ignore it altogether. I do not think that Chandrasekhar even mentions the problem, at any rate in the section on galactic dynamics.

The problem which Chandrasekhar handles is one that was originally formulated by the reviewer in 1915 as a side-problem, namely, a sub-system moving in the controlling field of a larger system. Looming behind it, there is always a further problem as to how the equilibrium of the larger system itself is maintained; in particular, there is the question whether the particular gravitational field which the sub-system demands is such as could be furnished by any admissible form of larger system. Thus the theory is better adapted to prove that certain kinds of distribution (for example, transverse star-streaming) are impossible than to prove that certain kinds are possible. In short, the 'solutions' satisfy necessary, but not sufficient, conditions for physical application. The view of galactic structure current in 1915 gave reasons for treating a sub-system, with density distribution markedly different from that of the stars as a whole, which do not apply to-day; and the primary justification for the 'side-problem' seems to have disappeared. Nevertheless, it is probably the most practicable way of approaching the main problem of an oblate galaxy. I think that Chandrasekhar's most important advance is to show that, if differential rotation exists, the sub-system can only be in a steady state if the potential of the controlling system has axial symmetry. It is interesting to notice that the recognition of galactic rotation, which might seem to be an unwelcome complication in a problem which already over-taxes our powers, actually makes for simplification, since his theorem ceases to apply when the rotation vanishes.

The dynamics of a star gas and of an atom gas are strongly contrasted; but the complete theory of the galaxy must include them both. For the galaxy comprises a stellar system and a cosmic cloud. It is still uncertain which part has the greater mass. It has generally been assumed that the stellar system is the more massive; but if it turns out that the main part of the controlling gravitational field is due to the cloud, the problem of the equilibrium and evolution of the galaxy will be substantially modified, and presumably simplified. In either case there is an important condition which galactic dynamics ought to take into account. Although the star gas and the cosmic gas are semi-independent systems governed by widely different forms of dynamics, the rotation (both absolute and differential) is known to be approximately the same for both. It would seem, therefore, that the distribution of rotation has to be compatible with both kinds of dynamics. It is just possible that, so far as the practical problem is concerned, we have been beginning at the wrong end; and the true starting point should be a study of the forms of distribution of a rotating viscous gas.

A. S. EDDINGTON.

FRUIT CULTURE

Modern Fruit Production

By Prof. Joseph Harvey Gourley and Prof. Freeman Smith Howlett. (Rural Text-book series.) Pp. vii+579. (New York: The Macmillan Company, 1941.) 18*s*. net.

THIS book is quite frankly written for the professional horticulturist, the serious student and the progressive grower of the United States. But a study of the book shows how extremely diverse are the environmental conditions experienced on that continent and what a wide range of fruit—from berry fruits to grapes and from citrus to cherries—comes within its purview.

The authors fully realize the vastness of the industry for which they are attempting to cater, and point out that the United States was responsible over a six-year period (1931–36) for the production of no less than one third of the world fruit output. Very wisely, therefore, they make no attempt to present a mass of experimental data which would but serve

to bewilder. Actually only fifty short tables in all appear on the 565 pages of exposition of general principles. There are in addition some eighty-seven pertinent diagrams and plates, which latter give a very good idea of the diversity of fruit-growing methods practised in the United States.

While the book contains more than seven hundred specific references to recent research, these are skilfully dovetailed into a clear account of up-to-date American practice. Where research in other countries, especially in Great Britain and the Dominions, bears upon general horticultural principles, it is not infrequently quoted. Although it is claimed that "Pomology has developed into a science in its own right, similar in its fundamental background to other plant sciences", the difficulties of drawing conclusions of universal application upon complex, long-lived, extensive-rooted fruit plants, so subject cumulatively to environmental influences, are frankly stated. The authors put an unanswerable case for the abandonment of a search for rule of thumb methods and stress the need for an appreciation of all the interdependent factors which alone can guide cultural practices from year to year. The complexity of the factors involved in such problems as fruit bud formation, fruit set, alternate year bearing and storage quality is clearly brought out, and the relationship of the orchard practices of pruning, cultivating, manuring and fruit thinning—which are designed to control these tendencies—is developed in parallel. Indeed no one can read the chapters dealing with these subjects without feeling more competent to deal with the practical problems and more conversant with the underlying principles. For example, while the classical experiments of Kraus and Kraybill on the carbohydrate nitrogen relationships in the fruiting tomato plant are brought into line with Hooker's investigations on flower formation in the apple for the benefit of the student, the fruit grower is assured by the practical conclusion that it is the leaf surface of the plant which is of paramount importance in bud differentiation, and he is directed to the alternative ways of maintaining or improving leaf surface, which can be appropriately chosen according to the condition of his orchard. The investigator is tempted to explore further the suspected presence of flower-producing hormones.

The arrangement of the individual chapters is somewhat puzzling to the European who, after reading Chapter 2 dealing with the "Fruit Plant and its Parts", is surprised to find that "Propagation and Stocks" are relegated to Chapter 15. Again, after reading about "Cultural Practices", "Fertilizers and Manures" and "Water Relations" in Chapters 6–8, disappointment is experienced that bare mention is made of Wallace's pioneer work on the diagnosis of nutrient deficiencies by leaf and growth symptoms. However, a handsome tribute to that work is only delayed until Chapter 14 which, incidentally, includes a useful summary of the symptoms of other 'physiological disorders'. It is realized that these seeming discrepancies are due to local emphasis in a country where nitrogen and moisture deficiencies have in the vast majority of cases been the limiting factors in orchards, and where large-framed trees planted 32–40 ft. apart have been the unquestioned order of the day. A few more specific cross-references in the earlier chapters would, however, not come amiss.

Some readers will be surprised to learn what a comparatively minor role pruning is given in the orchard practice of the United States to-day, but the statement that many growers are now pulling out their apple trees at 30–35 years old because of the reduction of fruit size and quality suggests that the pendulum may have swung too far in the direction of *laisser faire*.

Except in so far as diseases, pests and measures for their control affect 'tree condition', the authors have made no attempt to deal with pathological problems; consequently they have been able to cover the pomological field very fully and there are few established facts or practices which they have overlooked. Thus "Modern Fruit Production" should succeed in stimulating a much wider audience than it was designed to inform, and it will be welcomed as a clear summary of progress made in correlating the recent findings of horticultural science with economic fruit-growing practice.

The data collected by the Bureau of Economics of the U.S. Department of Agriculture, and supplied in Chapter 1, about the varieties, ages and localities of some hundred million bearing and non-bearing apple trees in the United States, should give food for thought to the fruit industry of Great Britain, which has no reliable statistical basis upon which to reconstruct its future.

R. G. HATTON.

FOREST TREE SEED

Forest Tree Seed of the North Temperate Regions, with Special Reference to North America

By Henry Ives Baldwin. (A New Series of Plant Science Books, Vol. 8.) Pp. xvi+240. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1942.) 4.75 dollars.

THE regeneration of forests depends, in the first place, on the seed of trees. The conditions which influence the production and germination of seeds, and the effects of environmental and hereditary factors on the nature of the plants they produce, and thus on the whole future of the crop, have been the subjects of extensive research and inquiry for many years. The results of original experiments have often a very limited circulation, reports are often published in obscure journals and the research worker and the practising forester have seldom either the time or the opportunity to search for them. It is, therefore, highly desirable that a synthesis and a digest of this extensive literature should be produced, and the present work meets this requirement very successfully.

A great deal of the interest in tree seeds has arisen from the expansion of artificial regeneration, afforestation and ornamental planting, so that it is not surprising that the greater bulk of this book is concerned with the artificial treatment of seeds, such as collection, storage, extraction, cleaning, testing, etc. Nevertheless, these are related to the reactions of seeds to their environment, and the author has kept this relationship to the forefront throughout.

The chapter on "Extraction and Cleaning" is particularly interesting. Descriptions of many kinds of apparatus are given, with diagrams, and the working of each is explained and commented upon, both from the point of view of their effect on the seed and their economic efficiency.

The subject of seed provenance is discussed in a chapter in which the work of investigators on some

of the most important European and American species is summarized. To the British reader it is regrettable that that of Münch, Rübner and others on the European larch is not included, but a selection had to be made and, for American readers, this species is of minor importance.

Though the artificial treatment of seeds and the requirements of artificial regeneration receive so much attention, the author rightly stresses the fact that the problems of natural regeneration are also bound up with seed production, storage, dispersal and germination, as well as the influence of biotic, climatic and soil factors on the survival of seeds in a viable condition and on the establishment of the seedlings as independent organisms. All these matters receive consideration in this work. The method of the author is to devote a chapter to each branch of the subject, giving a general account of the points investigated by different workers, with a summary of the most important contributions. Then a general review of the position is given, indicating points on which agreement is reached and those in which further investigation is called for. A very full bibliography is added to each chapter. At the end of the book is a useful glossary of seed terms with their French, German, Danish, Norwegian and Swedish equivalents, and a list of authors mentioned in the text.

The work will be indispensable to research workers in the field of tree seed and very useful to practical foresters and members of the seed trade. It is not a handbook of tree seed, giving cut and dried information about individual species, but a reference book and a guide, not only to existing knowledge but also to the directions in which that knowledge should be extended in the future. T. THOMSON.

NON-EUCLIDEAN GEOMETRY

Non-Euclidean Geometry

By Prof. H. S. M. Coxeter. (Mathematical Expositions, No. 2.) Pp. xv+281. (Toronto : University of Toronto Press, 1942.) 3.25 dollars.

THE philosopher Kant declared that Euclidean geometry was inherent in the human mind and expressed the truth about space. We now recognize that non-Euclidean geometry is equally valid as an abstract system, and that one particular form (due to Riemann) has more claim than Euclidean geometry to represent the properties of physical space. The transition from the old point of view to the new has revealed the true nature of geometry, and thence of mathematics in general, and has helped to build up the theory of relativity.

To survey their fields and build the pyramids, the Egyptians had a set of empirical rules, which the Greeks developed into a science. In particular, Euclid attempted to deduce the properties of straight lines and circles from certain definitions, axioms, and postulates. The axioms or "common notions" were regarded as self-evident truths, whereas the postulates were frankly assumptions, but most of them seemed so obvious that no one denied them. There was one exception, namely, the fifth postulate (often called the eleventh axiom) : *If a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than two right angles.* For centuries mathematicians, while not doubting the truth of this postulate, objected to it as too complicated. It was hoped to prove it by showing that a contradiction would arise from denying it or one of its simpler substitutes, such as 'Playfair's axiom' : *Two intersecting straight lines cannot both be parallel to the same straight line.* No contradiction was ever found. In 1823 Bolyai, and independently Lobatschewsky in 1826, worked out a system of geometry (now known as hyperbolic) quite as logical as Euclid's, but assuming that his parallel postulate was untrue ! Similar results had been obtained by Gauss even earlier, but for fear of ridicule he did not publish them.

A much greater departure from the Euclidean geometry appeared in 1854, when Riemann, using the methods of differential geometry which Gauss had developed from land-surveying, introduced a geometry (now called spherical) in which there are no parallels, and two straight lines enclose a space ! The relationship between the alternative geometries remained obscure until much later. Cayley (1859) showed that the 'metrical' properties of Euclidean space, such as distance and perpendicularity, could be derived analytically from the 'projective' (that is, non-metrical) properties of a certain conic called the "absolute". Klein (1871) developed this idea, and set up a general projective geometry, from which he obtained elliptic geometry (akin to Riemann's), parabolic (Euclidean), and hyperbolic. He also showed the existence of 'models' or correspondences, by which it could be deduced that one geometry is logically self-consistent if another is so. (Dr. Coxeter thinks that the only ultimate test of consistency is based on the properties of the physical world as interpreted by our senses.) More searching investigations into the logical structure of geometry were made by Pasch (1882) and Hilbert (1901). The word "axiom" is now used for an assumption concerning the relationship between certain *undefined* terms such as *point* and *straight line*, and there are an infinite number of geometries corresponding to the infinite choice of the set of axioms, which may be freely chosen as long as they are self-consistent. Naturally, those which agree closely with the properties of physical objects are of most interest, in particular Euclidean geometry because of its simplicity, and Riemannian because of its use in relativity.

Dr. Coxeter's book starts with an excellent introductory chapter, mainly historical. Chapters 2 and 3 are on projective geometry, and instead of defining polarity with reference to a conic, follow von Staudt by defining polarity as "a correlation of period two" and then look for a corresponding conic. Chapter 4 is on homogeneous co-ordinates. After these somewhat prolonged preliminaries, elliptic geometry is obtained from projective geometry, since every axiom of the former is valid in the latter. This idea is developed in Chapters 5, 6 and 7. In Chapters 8 and 9, Euclidean and hyperbolic geometry are derived from a general 'descriptive' geometry. The remaining five chapters are simpler, dealing with hyperbolic geometry in two dimensions, circles and triangles, a general triangle of reference, area, and Euclidean models. The book concludes with a bibliography and an index. It will appeal to those who have already a first acquaintance with the subject and are ripe for a systematic treatment. H. T. H. PIAGGIO.

Soils and Soil Management

By Prof. A. F. Gustafson. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. viii+424. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 21*s*.

THIS book sets out to describe the principles of soil management from a practical point of view in a way that should be intelligible to the modern farmer or to students taking advanced courses in agricultural colleges. The author covers the whole field of soil management including, on one hand, such subjects as soil cultivation, erosion control, dry farming and irrigation and, on the other, fertilizers, manures and crop rotation. He naturally chooses most of his examples from the United States and tends to emphasize points of importance to that country, but this restriction does not detract from the book's educational value for students outside that country, although some of the detail will naturally not apply.

The main criticism of the book is that the scientific principles underlying the practice are not always clearly brought out. This is especially unfortunate in those subjects in which there is no traditional background of knowledge to help the reader pick out those particular details of practice that would be applicable outside the agricultural regions described. A minor criticism is that the introductory chapters on what is often called soil science, namely, soil formation, soil micro-organisms, soil organic matter and soil water are too sketchy to be really helpful, and, in addition, that on soil water is not up to date. The main part of the book, on soil management proper, does not suffer from this latter defect. The subjects are treated fully, particularly on the practical side, and the text is illustrated with a large number of well-chosen figures. E. W. R.

The Riddle of Religious Education and a New Solution

By Adam Gowans Whyte. (Thinker's Forum, No. 22.) Pp. 48. (London: Watts and Co., Ltd., 1942.) 6*d*. net.

IN the course of an article which appeared in NATURE of November 14 last, the position was maintained that the omission from the religious instruction of senior pupils of all reference to faiths other than the Christian would be hard to justify in these times. Mohammedans and Buddhists, Hindus and Parsees, Jews and other non-Christians, are fighting on our side in a war of good against evil—a struggle for a way of life which for many of us, but not for any of them, finds its historical expression in the New Testament. This position is very strongly maintained in Mr. A. G. Whyte's ably and vigorously written pamphlet. The body of the pamphlet is devoted to a brief historical review of all that has led up to the "dual system" of control. The writer makes some apposite quotations from eminent Churchmen who have been quite unhappy about the working of that system. His "new solution" goes all out for making religious instruction broader and more objective. He maintains that a fraction of the time spent during a child's school life in expounding the details of the Christian creeds would suffice to convey an intelligent appreciation of the fundamentals of other creeds, and to engender a more sympathetic attitude towards the millions who share our essential aims.

Annual Reports on the Progress of Chemistry for 1941

Vol. 38. Pp. xxxii+326. (London: Chemical Society, 1942.) 15*s*.

IT would be unprofitable to attempt to crystallize an already highly concentrated essence, and indeed all that is required is a reminder that these valuable reports continue to appear without interruption. Work on diamagnetism in recent years is summarized with special reference to its relation to problems of molecular structure, and developments in the chemistry of the carbonyls and nitrosyls since 1934 are surveyed. A comprehensive report on organic chemistry deals with physico-organic topics, organometallic compounds, polysaccharides, synthetic polyenes, polyterpenes, natural quinone pigments, and heterocyclic compounds. That on crystallography relates to temperature effects in the reflexion of X-rays from crystals, and to metal, inorganic, and organic structures. Among the biochemical subjects discussed are the vitamins, particularly their assay, since it is now recognized that definite minimal quantities are needed to prevent deficiency diseases, and larger quantities to prevent subclinical deficiencies. In view of war-time restriction on the importation of fruits, the incidence of vitamin C in raw and prepared green vegetables is of special interest. Another topic is the utilization of carbon dioxide by bacteria and animal tissues. Analytical methods are reviewed, and the book closes with a chapter on radioactivity and sub-atomic phenomena, in which a historical introduction is followed by a survey of present knowledge of nuclear processes and of the concepts used in explaining and predicting them.

Reports of the Progress of Applied Chemistry

Issued by the Society of Chemical Industry. Vol. 26, 1941. Pp. 545. (London: Society of Chemical Industry, 1942.)

EXCEPT for an additional short section on starches, the chapters of this report correspond to those of the immediately preceding volume in the series. Vast as is the field surveyed, there can be no doubt that real progress is substantially greater, for much valuable information is necessarily being withheld from publication during the War. Many of the subjects discussed find emphasis, if not their origin, in the special demands of war-time needs; in this class are, for example, the manufacture of butadiene for synthetic rubber, substitute materials for ceramic products and the use of commoner in place of relatively rarer metals (as in the substitution of aluminium by zinc or tin-zinc alloy for milk-bottle caps). The section on plastics continues to reflect great interest and noteworthy progress, with an ever-more complete fusion of "academic" and "technological" research. The supply of glycerin from soap manufacture can now be supplemented by its synthesis from propylene by way of allyl alcohol; and the physical properties of soaps and their solutions continue to attract much attention. In the section on sanitation and water purification there is reference to fluorosis arising from fluorine in drinking water: and there is quoted evidence that the incidence of goitre does not correspond to the iodine or the fluorine content of the water but may be of fungal origin. The year in review was marked by the pooling of research resources by five important drug manufacturers in Great Britain.

RESONANCE AND CHEMICAL REACTIVITY

By PROF. M. POLANYI
University of Manchester

OUR ideas on the mechanism of chemical reactions are still in flux, and the search for the most suitable conceptual framework continues. The following notes attempt a further slight shift in perspective, which seems to be well suited for surveying some of the more recent additions to this field of inquiry[1].

The nature of molecular structure has undergone in the last ten years a considerable degree of reinterpretation in the light of quantum-mechanical resonance. Wherever alternative bond assignments are possible—even though these may often seem of a rather remote and altogether speculative character—it now appears useful to take these into account and to represent the actual state of the molecule as resonating between all the component pure states.

We may extend this view by considering the initial and final states of a chemical reaction as alternative bond assignments of the same atomic system. In this sense, for example, $H_2 + I_2$ would be considered as one of the two pure states of which a system of 2H and 2I atoms is capable, the other pure state being represented by the alternative bond assignment HI + HI. Denote the eigen-functions characterizing the electron distribution in the pure initial and final states by ψ_i and ψ_f respectively, then the electronic distribution of the system is characterized in general by $\psi = \alpha_1\psi_i + \alpha_2\psi_f$. In these terms the chemical reaction signifies a continuous change of the coefficients α_1 and α_2, by which α_1/α_2, starting from very small initial values, achieves in the end values approaching infinity. The change can be seen to depend on the atomic co-ordinates. Take as an example the reaction

$$\underbrace{Na + Cl}_{x} - \underbrace{CH_3}_{y(=y_0)} = \underbrace{Na - Cl}_{x(=x_0)} + \underbrace{CH_3}_{y}$$

where y_0 signifies the normal bonding distance of C–Cl and x_0 the normal bonding distance of Na Cl. Initially $\alpha_1 \gg \alpha_2$ when x is large and $y = y_0$, whereas finally $\alpha_1 \ll \alpha_2$ when y is large and $x = x_0$.

We will suppose that—owing largely to the steric effects of the substituents attached to the central carbon—the reaction proceeds so that the distances x and y remain colinear, and making use of this simplified condition we will try to predict the activation energy of the reaction. Let E_i and E_f denote the energies of the pure initial and final states; and denote at the beginning of the reaction $E_i = E_i^0$, while at the end $E_f = E_f^0$. All the configurations of the atomic system which lie between these two stable configurations are necessarily unstable, and hence their energies lie higher than either E_i^0 or E_f^0.

Of particular interest among these unstable configurations are the 'transition states' in which $\alpha_1 = \alpha_2$, and for which the energies of the pure initial and pure final states coincide. The lowest of these is usually called '*the* transition state' or 'the activated complex' of the reaction, and the theory of chemical reactions consists mainly in attempts to predict the energy level of this state—by which the activation energy of the reaction is determined.

To obtain this level in our case, we introduce the further simplification that in the opening phase of the reaction the sodium atom can approach the chlorine atom to within the normal bonding distance x_0 without incurring appreciable repulsion. Hence we may imagine that the reaction starts with $x = x_0$, and that the x variable remains at this value throughout the reaction, while all the variations of the energy are determined by changes in y. In the pure initial state the variation of energy is seen to consist in the changes of the attraction energy (E_{iy}) of the chlorine-carbon bond; in the pure final state it lies in the changes of the repulsion energy (E_{fy}) arising between the chlorine and carbon atoms in the non-bonding state. Consequently we have $E_i = E_{iy}$ and $E_f = E_f^0 + E_{fy}$.

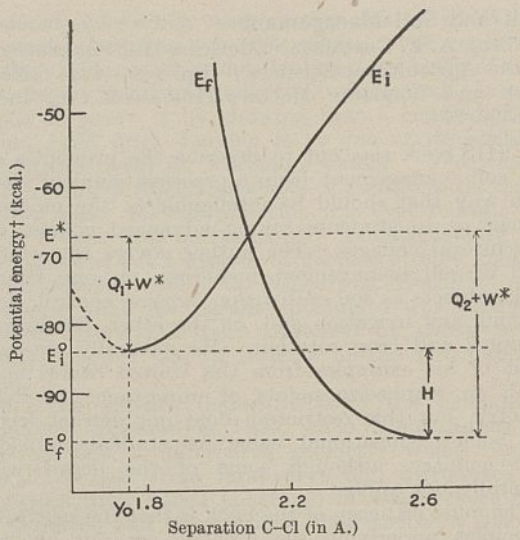

Fig. 1. MECHANISM OF REACTION
$Na + Cl\,CH_3 = NaCl + CH_3$

E_i energy of extended C–Cl bond.
E_f energy of repulsion between H_3C and $Cl^-(Na^+)$ plus normal bond energy of NaCl.
y_0 normal bond distance C–Cl.
E_i^0 and E_f^0 energy before and after reaction.
E^* energy of transition state.
W^* resonance energy in transition state.
Q_1 and Q_2 activation energies of forward and back reactions.
H heat of reaction.
† Counted from level of free particles Na, Cl, CH_3.

By plotting both E_i and E_f as a function of y (Fig. 1) we find the point where their values coincide (E^*). This would represent the energy of the transition state, but for the fact that we have not yet taken into account the resonance energy which is bound to arise when a system of atoms can be represented by more than one bond assignment. This resonance energy will be negligible at the beginning and at the end of the reaction, and will reach high values only in the neighbourhood of the transition state. Therefore, if we define E^* as the energy at which levels of the pure states coincide, and call the resonance energy at the transition state W^*, then the activation energies Q_1 and Q_2 are defined by $Q_1 = E^* - E_i^0 - W^*$ and $Q_2 = E^* - E_f^0 - W^*$. Thus by determining E^* we can find $Q_1 + W^*$ and $Q_2 + W^*$, but not the values of Q_1 and Q_2 themselves.

However, in the case of $Na + Cl\,CH_3$ (and other 'ionogenic' reactions) it is possible to get a little further, without undertaking the difficult and uncertain calculation of W^*. An evaluation of the diagram in Fig. 1 for $Na + Cl\,CH_3$ yields $Q_1 + W^* =$

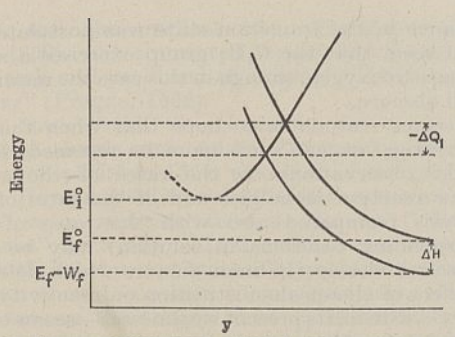

Fig. 2. CONNEXION BETWEEN CHANGES IN REACTION HEAT AND ACTIVATION ENERGY. ($\Delta H = W_f$ AND ΔQ_1 ASSUMED TO BE EQUAL TO ΔE^*).

16 kcal., whereas Q_1 observed[2] is 10 kcal. Thus W^* appears to be not excessively large, and we may well try to analyse the effect of replacing methyl by other radicals in the hope that the effects of such variations on W^* may be small or at least not entirely unpredictable. Take first a radical like allyl or benzyl, which resonates in the free state, whereas resonance is absent in the corresponding molecule. This causes a depression of the energy of the final state by the amount of the resonance energy W_f, the heat of reaction H being increased by $\Delta H = W_f$ (Fig. 2). The pure final state will be affected throughout in this sense and the $E_f y$-curve will be shifted bodily downwards—as shown in Fig. 2—by the amount W_f. The result is to depress the level E^* by $\Delta E^* = -\alpha W_f$, where α is a fraction depending on the angles of inclination at the crossing of the E_i and E_f curves. The value of α obtained from the diagram for our case is about 0·27.

We may add another relationship for the case that it is the R–Cl molecule which resonates whereas this time resonance is absent in the free radical. Vinyl chloride and chlorbenzene are compounds reliably assumed to be of this kind[3]. We may expect here a reduction of the heat to the extent $-\Delta H = W_i$ and also a corresponding elevation of the level E^* by $\Delta E^* = \alpha W_i$.

In this scheme W^* remains unaffected and the rate of reaction as determined by Q_1 should vary in a predictable way. There should be a decrease of Q_1 by $-\Delta Q_1 = \alpha W_f$ in the first instance and an increase $\Delta Q_1 = \alpha W_i$ in the second. Both cases would be covered by the relationship $\Delta Q_1 = -\alpha \Delta H$, which expresses a kind of revived Berthellot principle, connecting rates of reaction with heats of reaction (Fig. 2).

The conditions in which such a relationship can be postulated are clearly of a very special kind. They can be upset even for our chosen reaction—chosen for its particular simplicity—whenever there are present in the transition state additional bond assignments which do not appear either in the initial or the final state[4]. Suppose there is an oxygen atom present in ClR, as, for example, in $ClCH_2(CO)CH_3$. There is then the possibility that the $Na + ClCH_2(CO)CH_3$ transition complex will resonate with the alternative bond assignment $Na^+ + ClCH_2(C^{\cdot}{-}O^-)CH_3$. From this there will result an addition (W_1^*) to the resonance energy in the transition state and the activation energy will be reduced by an equal amount.

There is a further complication arising from the fact that in the free radical there is a lone electron which will tend to resonate in about the same way as the valence electron of sodium, causing, for example, in the radical $.CH_2(CO)CH_3$ the additional bond assignments $^+CH_2(\dot{C}{-}O^-)CH_3$ and $CH_2 = (C^+{-}\dot{O}^-)CH_3$. Hence there will be present also a certain amount of resonance energy (W_f) in the free radical, and the total depression of the activation energy will show the combined effect of W_1^* and W_f, so that $\Delta Q_1 = W_1^* + \alpha W_f$. Since we cannot calculate W_1^*, we can expect to ascertain this peculiar effect of the CO group (or of any other negative group having a similar function) only qualitatively by the existence of a ΔQ_1 that is distinctly larger than $-\alpha \Delta H$.

The experimental material which so far has been analysed in the sense of these ideas is collected in the accompanying table. A glance at the first column

Radical (R)	Activation energy $Na + Cl R$ (Q_1)	Substitution heat: $RH + OH = ROH + H$ (Rossini[5])	First order constant of IR pyrolysis at 430° (k)	Activation energy of IR pyrolysis (Q_1')
vinyl	10·4		6	55
phenyl	10·4		14	54
methyl	10·0	16·0	14	54
ethyl	9·4	10·2	50	52
n-propyl	9·2	8·8	250	50
n-butyl	8·6	8·2	560	49
*iso*propyl	8·6		4000	46
t-butyl	7·8		9000	45
allyl	6·0		600000	39
acetyl	5·0		160	(51)
benzoyl	0		18000	44
acetonyl	2·0		9000	45
benzyl	2·9		23000	44

of figures shows that there is a distinct depression of the activation energy (as compared with $ClCH_3$) in a number of instances where an increased heat of reaction may be expected on account of resonance in the final state. Allyl-, benzyl- and acetonylchloride belong to this class. We also note that the two compounds, vinyl- and phenyl chloride, which react more slowly than methyl chloride, are both of the kind in which resonance would decrease the heat of reaction.

There is also a good deal of evidence favouring the assumption that the observed falling activation energies in the series methyl, ethyl, *n*-propyl, *n*-butyl, correspond to a parallel increase in the heat of reaction. In the second column of the table is a list of reaction heats, which show that the difference of the bond energies R–H and R–OH goes on decreasing all along the series. The only explanation for this effect seems to be the presence of a radical resonance of the type $CH_3 - CH_2^{\cdot} \longleftrightarrow H^{\cdot} \ldots CH_2 = CH_2$ which weakens both the R–H and the R–OH bond, but affects the latter to a much less extent[6,7]. Moreover, claims to have actually observed a fall in the bond energy of C–H by passing from CH_4 to C_2H_6 were quite recently made by D. P. Stevenson[8] and, independently, by Anderson, Kistiakovsky and Van Arstdalen[9], the values being given as $D(CH_3{-}H) = 101$ kcal. and $D(C_2H_5{-}H) = 96$ kcal. in the first and as $D(CH_3{-}H) = 102$ kcal. and $D(C_2H_5{-}H) = 98$ kcal. in the second instance.

Once a resonance of the type $CH_3 - CH_2^{\cdot} \longleftrightarrow H^{\cdot} \ldots CH_2 = CH_2$ is assumed to be effective, an even stronger effect of this kind must be taken to be present in secondary and tertiary radicals such as $(CH_3)_2CH^{\cdot}$ and $(CH_3)_3C^{\cdot}$. This would cause a marked fall in the heat of reaction in the series ethyl, *sec.*-propyl, *tert.*-butyl and make the observed fall in the activation energy in this series appear as a further qualitative corroboration of the above theory.

A further corroboration of at least an approximately quantitative kind can be based on observa-

tions of the pyrolysis of compounds in which chlorine is replaced by iodine. In a series of experiments made during 1938–40 and now in the course of publication, E. T. Butler and I observed very wide variations in the rates of pyrolysis of different iodides[12]. The observed rates extrapolated to a common temperature 430° C.—listed in the table—vary in a sense largely parallel to the rate of the sodium vapour reactions of the corresponding chlorides. The experimental conditions of the pyrolysis were such that the rate was likely to be governed primarily by the monomolecular dissociation of the C–I bond. If that is so, then $Q'_1 = (13 \log k)RT$ should correspond approximately to the energy of that bond. This assumption is supported by the fact that the Q'_1-values calculated for methyl iodide and ethyl iodide from this relationship closely correspond to the C–H bond energies mentioned above[10] and established quite independently after the preliminary publication[11] of our results. The table shows further a reasonable measure of agreement with such variations in bond-energy as may be expected to occur from considerations of resonance. On these grounds we felt justified in attempting a verification of the relationship $\Delta Q_1 = -\alpha\Delta H$ by setting $\Delta H = \Delta Q'_1$ (Fig. 3).

It is clear that for the compounds listed in the figure a marked parallelism exists between activation energy and the postulated variation of reaction heat. It is also clear that the proportionality factor α is—as the theory requires it to be—a fractional magnitude, somewhat less than one half. It so happens that the straight line in Fig. 3 drawn by the method of least squares defines a factor $\alpha = 0{\cdot}28$ which actually agrees closely with the value derived for α from Fig. 2; but this precise correspondence must be regarded as a mere coincidence.

Fig. 3 does not contain the three oxygen-containing compounds acetyl-, acetonyl- and benzoyl chloride, nor does it contain benzyl chloride. In all these cases the activation energies are much lower than the relationship $\Delta Q_1 = -\alpha\Delta H$ would lead one to expect, and the values fall altogether out of the picture. This is exactly what we predicted above for the oxygen-containing compounds, for which an extra resonance in the transition state was postulated. It would seem that the C_6H_5 group exercises a similar influence to oxygen, though in this case the mechanism is still obscure.

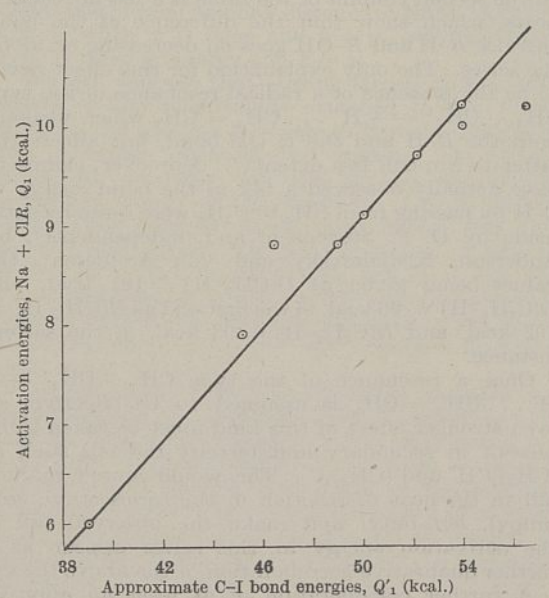

Fig. 3.

It seems reasonable to hope that when this kind of investigation can once more be resumed, further parallel observations on the rates of the sodium vapour reaction of halides and of the rates of their pyrolysis (compared also with the rates of some corresponding reactions in solution) may be found to disclose clearly the main factors which determine the effect of chemical substitution on reactivity. The theory—with all its present weaknesses—seems to have allowed us to recognize the type of reactions in which the simplest conditions are likely to prevail, as well as the factors that have to be considered in the first place when analysing the results.

[1] Systematic speculations on the mechanism of chemical reactions were first started by F. London (1928) and by H. Eyring and M. Polanyi (1931). The simplified theory of 'ionogenic reactions' used in the text was first suggested by Ogg and Polanyi (*Trans. Far. Soc.*, **31**, 607; 1935) and later elaborated by M. G. Evans and Polanyi (*Trans. Far. Soc.*, **34**, 11; 1938).

[2] Compare Evans, M. G., and Warhurst, E., *Trans. Far. Soc.*, **35** 593 (1939).

[3] Brockway, L. O., Beach, J. V., and Pauling, L., *J. Amer. Chem. Soc.*, **57**, 2693 (1935).

[4] Such a possibility was first considered by M. G. Evans and E. Warhurst for the case of the diene-synthesis (*Trans. Far. Soc.*, **34**, 614; 1938) then applied to the present problem by M. G. Evans and M. Polanyi (NATURE, **148**, 436; 1941).

[5] Rossini, F. D., *Bull. Bur. Standards J. Research*, **13**, 29, 189 (1934). Knowlton, J. W., and Rossini, F. D., *ibid.*, **22**, 115 (1939).

[6] Wheland, G. W., *J. Chem. Phys.*, **2**, 474 (1934).

[7] Baughan, E. C., Evans, M. G., and Polanyi, M., *Trans. Far. Soc.*, **37**, 377 (1941).

[8] *J. Chem. Phys.*, **10**, 291 (1942).

[9] *J. Chem. Phys.*, **10**, 305 (1942).

[10] Compare Baughan, E. C., and Polanyi, M., NATURE, **146**, 685 (1940).

[11] Butler, E. T., and Polanyi, M., NATURE, **146**, 121 (1940).

[12] *Trans. Far. Soc.*, **39** (1943).

SOME EARLY CZECH CONTRIBUTIONS TO BOTANY

By DR. GERALD DRUCE

IN Bohemia the science of botany began, as elsewhere, through its applications in medicine and agriculture. A consideration of the uses of plants led to the first Czech writings on the subject before there was any idea of a study of plants for their own sake. Herbals, containing descriptions of local plants, began to appear in the fourteenth century and were more or less elaborately illustrated. Probably the earliest in Bohemia was the "Lekarszké Knizky" or "Erbarius", of Christian of Prachatice, who was a *Magister* of the University of Prague, where he taught between 1392 and 1435. It listed 156 plants, and this was first printed from the original manuscript in the sixteenth century[1].

Of more importance was the "Kniha lekarzská kteraz slowe Herbarz, aneb Zelinarz" of Jan Černý (1480–1530). It was first printed at Nuremberg in 1517, then at Prague in 1544 and 1554, and at Olomouc in 1554, and was illustrated with woodcuts and had considerable importance, as its many editions indicate. It was, in fact, more than a herbal since it contained accounts of minerals and inorganic substances then used in medicine, for Černý was primarily a medical man interested in plant products.

Other early Czech herbalists include P. A. Matthiolus, who also wrote a commentary on Dioscorides

(1554), and the medical man, Thaddaeus Hájek (1525–1600), who translated Matthiolus's Latin work into Czech and produced an original "Herbarz ginak Bilinarz" (Prague, 1562).

The first Czech to claim to be a botanist pure and simple was Adam Zalužanský, born at Mnichovohradiště in 1558, who died of the plague in 1613. He was the first writer to advocate a study of plants as a separate science. In his "Methodi Herbariæ" he wrote: "It is usual to connect medicine with botany, yet scientific treatment demands that we should consider them separately. For in every science the theory must be dissociated from practice and the two must be dealt with separately in their proper order before they can be united. Botany (which is, as it were, a special branch of physics) should form a unit by itself before it can be brought into connexion with other sciences." Zalužanský was a remarkable man. He graduated at Prague in 1581 and after some years of travel returned to lecture on natural philosophy. He was elected rector of the University in 1593 and attempted to re-organize the curriculum as well as introduce complete religious freedom and secularize the University. He wanted especially to advance and broaden the teaching of science. His work, "Rzad Apothekarzský" (1592), set forth the scope and aims of pharmacy and the duties of apothecaries towards the community. As a botanist he has been compared with Cæsalpino, and though his herbal was not in advance of contemporary publications as regards the number of specimens described, it was unique in giving a comprehensive survey of botany as a distinct subject. In his classification he began with fungi as the lowest (known) organisms, passing to mosses, then ferns, grasses, other flowering herbs, and concluding with trees. He endeavoured to pass from simpler to more complex types and evidently regarded lower cryptogams as primitive types. Considerable importance was attached to leaf appearance, and this led him to class umbellifers and even some of the composites with the ferns.

The contemporaries of Zalužanský included Jacob Hořčický (1575–1622), keeper of the gardens of Rudolf II and Jan Jesenský, or Jesenius (1566–1621), a Silesian Czech naturalist and medical man who became rector of the University of Prague and was among the anti-Hapsburg intellectuals executed in 1621. Hořčický, or Sinapius, was court apothecary and specialized in the cultivation of herbs which he distilled in steam (according to a method probably acquired from Černý's herbal) to yield aromatic "waters" which are credited with curing Rudolf from an acute attack of gout so that the emperor ennobled him with the title, *von Tepenec*.

Zalužanský died just before the disturbing times of the Thirty Years' War and its persecution of the Czech people. All progress in science was checked for a hundred years. Except for occasional references to botany and other sciences scattered through theological writings, no attempt was made to impart any scientific knowledge in the schools or at the University. One such reference is that of Marcus Marci in "Idearum operaticum idea" (1667), where an account is given of "metamorphosis" in plants. Importance out of all proportion to its scientific merit, therefore, is attached to the collection of plants made by the priest, J. F. Bečkovský (1658–1725). It contained about two hundred specimens, but Bečkovský was an amateur rather than a serious botanist and knew only the herbal of Matthiolus. He confused many different plants and frequently assigned wrong names to his specimens.

In 1662 the University of Prague received new statutes. One of these provided for five professors in the medical faculty, including one for botany. The curriculum was to include a study of medicinal plants, to be undertaken in the summer of the first year of study, and in the third and fourth years instruction was to be given in the preparation of plant medicines. Science, however, did not flourish, and in 1688 the faculty had only three professors and four unpaid assistants. What lectures there were in botany were given by the professor of anatomy and surgery. Between 1649 and 1740 thirteen lecturers in botany were appointed and not one made the subject his first interest. Two of them, J. J. V. Dobřenský (1632–97) and J. A. Scrinzi (1697–1773), are worthy of some consideration. Dobřenský was a medical man who had studied in Modena and Ferrara. He knew more chemistry than botany though he taught both and wrote about a dozen Latin works on natural science and medicine. Scrinzi was the first occupant of the chair of chemistry and physics at Prague. He practised medicine at Mladá Boleslav, about thirty miles north-east of Prague. It was Scrinzi who demonstrated the evacuated 'Magdeburg hemispheres' before Maria Theresa in 1754, using two teams of horses that failed to draw them apart.

In 1755 K. Sagner (1721–81) was lecturer in botany and printed for his students a work entitled "Institutiones Philosophicæ", which contained a general account of botany, including a carefully arranged section of plant physiology as then understood. He was one of those appointed as a result of the changes introduced during Maria Theresa's reign (1740–80) through the insistence of her physician, Gerhard van Swieten. The first professor of botany and materia medica was a Dr. Scotti, who planned a physic garden in 1752 and by which he is remembered. His successor was a Czech, Jan Bohadsch, or Bohač (1724–68), whose lectures had to cover the whole field of natural science. He made excursions all over Bohemia to collect material for a monograph, "Flora, fauna et historia lapidei Bohemiæ", which remained, however, in manuscript. After his death during an excursion in west Bohemia there was no professor in natural history until 1775, when his pupil, J. J. Zauschner (1737–99), was appointed. Zauschner made various contributions to the advancement of botany in Bohemia, including the re-discovery of *Gagea* (*Ornithogalum*) *bohemica*[2] mentioned by Černý, but afterwards overlooked. At this time it became possible to announce discoveries and to describe unusual plants and other scientific phenomena, since in 1770 there was formed a society for the advancement of science. It was at first styled the *Privatgesellschaft* (*Učená Společnost*, or 'learned society'), but in 1784 adopted the more expressive title of Royal Bohemian Scientific Society (Kralovská Česká Společnost Nauk). Among the original members were Bohač, Zauschner and another botanist, Jan Mayer, and it had several patrons among the nobility. In 1774 the Society offered prizes for work in science, and these were awarded to K. Sandberg of Brno and A. Voigt of Vienna. Sandberg's essay directed attention to the absence of an adequate Flora of Bohemia, and this prompted botanical excursions to various parts of the country, particularly to the Giant's Mountains. The Society published the results of these expeditions in a series of essays which gave an impetus to the study of plant life. Notable

among them were the observations of Thaddæus Haenke (1761–1817). His detailed work on the flora of north Bohemia brought him into prominence and led to his famous expedition to South America under the patronage of Count Sternberg. The masses of material he dispatched to Prague were later the subject of a handsome work in two volumes known as the "Reliqueæ Haenkeanæ", in the production of which the best Bohemian botanists collaborated.

The first attempt at a complete Flora of the country was that of F. W. Schmidt ("Flora Boemica"), which appeared in 1793–94. It was, however, uncritical and included plants that the author guessed would be found in naturally rich areas like the Giant's Mountains and the Bohemian Forest. A second attempt was made by Prof. Jan Novodvorský (1773–1810), but his manuscript was burnt just before he died. A third work, by J. E. Pohl (1782–1834), was also fated to remain unfinished, though two parts of his "Tentamen Flora Boemiæ" did appear in 1817. Pohl's flora was based on his own observations and on those of others which could be verified by visits to the localities where the plants grew.

Far superior was the "Flora Čechica" of the brothers J. S. and K. B. Presl. It had been completed in 1812, but was not printed until 1819. The preface was in Latin and was followed by a section in Czech, *Napomenutí* (reminders), in which the authors explained how they revived Czech botanical terms and also introduced new ones where needed by adapting Polish or Russian expressions to bring the subject into line with the Linnean system, which they followed in compiling the Flora. J. S. Presl, who did so much to advance the study of science among the Czech people, whereas his brother was more occupied in original investigations, particularly in connexion with the study of ferns, wrote a general text-book of botany ("Rostlinář", 1822), which included introductory biology, plant chemistry, besides anatomy, plant physiology and what would now be styled ecology. The illustrations were remarkably faithful, and some copies were hand-painted by his sister. It served as the basis for later Czech botanical treatises, and most of the terms used for flowering plants are still applied to-day, but those relating to cryptogams have largely disappeared or undergone alteration.

In addition J. S. Presl wrote an elementary botany and also an advanced work, "Všeobecný Rostlinopis" (general botany) in two volumes of more than two thousand pages. It appeared in 1846, and four thousand copies were circulated, a remarkable tribute to the interest in botany shown by a small nation in the middle of last century. K. B. Presl's work reached a more international public since he wrote mostly in Latin. Fourteen of his papers are listed in the Royal Society's catalogue of scientific papers. His books include a classic on ferns, "Testamen Pterodographiæ" (1836), with beautifully executed plates, many of the species being described for the first time. It classified 117 genera, and a supplement in 1845 brought the total to 132. This was his greatest work, though he also wrote a monograph on lobelias[3].

Several nobles, who were landowners in Bohemia, also encouraged the development of science. Thus, Count Malabaila Canal (1745–1826) was interested in applied science, cultivated a garden of economic plants and founded a lectureship in applied botany, the last lecturer being K. B. Presl. He encouraged the growing of sugar beet and established the first Czech factory for its extraction. He also improved fruit cultivation by introducing better grafting methods. Count Berchtold encouraged the cultivation of more potatoes, patronized contemporary botanists, and was a generous supporter of the National Museum. He wrote a standard work on the potato, and also a book on economic plants[4]. But the greatest botanist among the Bohemian nobles was Count Kaspar Sternberg (1761–1838), who not only supported contemporary Czech men of science but also was himself an investigator and author of considerable merit[5]. Most of his seventy-four works were in German, though he refers to Czech as "our tongue" and he translated some Czech mining notes into German in his paleobotanical treatise, "Flora der Vorwelt". He was instrumental in founding the Bohemian National Museum in 1818, became its first president, and gave it his herbarium of 9,000 specimens, to which he added purchases from abroad and the collections sent by Czech botanists from overseas. Sternberg also appointed Palacký, the historian, to be editor of the Museum's quarterly journal, and this has since been a powerful propagator of science among the Czech nation up to the present time. His last public function was to preside over a congress of medical men and naturalists at Prague, and he took great pride in announcing the recent discoveries of Purkyně, the Presls and others, to show that the Czech nation was making its contribution to the advancement of science whatever might be the truth of Liebig's recent assertions concerning the low level of science in Austria[6].

[1] The works mentioned in this article were consulted at libraries of the Czech National Museum, the Charles University and other institutes in Prague, and at Brno and Litomyšl in Czechoslovakia. Some works were read at the British Museum and at the library of the London School of Slavonic Studies.

[2] Much information relating to the development of botany in Czechoslovakia is contained in "Vývoj české Přírodovědy" (Development of Czech Natural Sciences) edited by the late Dr. L. Viniklář, 1932).

[3] K. B. Presl's name is attached to seven species of ferns native to Britain according to G. C. Druce's "Pocket Handbook to British Plants". Riley's "Catalogue of Ferns" (London, 1841) contained "additions by C. B. Presl".

[4] Berchtold, "Die Kartoffeln" (Prague, 1842).

[5] NATURE, **139**, 1028 (1938).

[6] *Liebig's Annalen*, **25**, 339 (1838).

WAR-TIME NURSERY SCHOOLS

By MRS. F. A. OGDEN

SCHOOL nurseries are not by any means new ventures even in Great Britain, but war-time conditions are responsible for their immediate expansion and improvement. Nursery schools for the care of the 2–5 year old children were established by local authorities in many parts of England during the 1914–18 period and afterwards, but in very few cases was there accommodation adequate to the growing needs. Schools were started in an experimental sort of way, and the permissive attitude of the Board of Education seemed to encourage the lull in progress. It would have been fortunate for the country if every local education authority had been in control of sufficient nursery schools to cope with all the 2–5 year old children in 1939. When war broke out and the call for women in industry became accentuated, so the need for proper accommodation for their young families made itself felt, and war-time nurseries were speedily developed. In some centres new nursery schools were prepared or completed. In many, nursery classes were established in the junior

schools and these brought a new low age-level of infant classes where, in difficult circumstances, children under two years of age were admitted. In more isolated places day nurseries were set up by voluntary bodies and these experiments certainly played a part in urging accommodation to meet the new needs. To release young mothers for essential war production, residential nurseries for children of less than two years of age became necessary, and maternity and child welfare committees of local authorities acting under the Ministry of Health made rapid progress in providing suitable accommodation. Grants to local authorities for establishment and maintenance by the Government were very generous, and the needs of the population of working mothers in most industrial areas was in some measure supplied. In the years 1937 and 1938 immediately preceding the War there were 107 nursery schools in Great Britain, registering an average attendance of 8,274 children less than five years of age. Thus it will be seen that a very small proportion of the population was then accommodated. In addition to further schools of this type in 1942, there were more than 1,000 day nurseries, 400 residential nurseries and 500 more in course of preparation. Nurseries of to-day can be grouped under the following heads :

(1) Nursery schools (under the authority of the local education committee and the Board of Education), day only ;

(2) War-time nursery classes (under the authority of the local education committee and the Board of Education), day only ;

(3) Residential war nurseries (under the authority of the Maternity and Child Welfare Committee and Ministry of Health), 24 hours or 6 days.

(4) Voluntary nurseries controlled by other voluntary organizations, such as the Women's Voluntary Service, Canadian Red Cross, British Red Cross, Anglo-American War Relief Fund, etc.

In day-nursery classes difficulties arising from war conditions, such as hours of work of parents on night shifts, etc., had to be met, and it became necessary to revise the hours of attendance of teaching staff in the junior schools affected. It would be impossible to pay too high a tribute to the young teachers who took voluntary duty at 6 a.m. or stayed until 8 p.m. to meet the convenience of war working mothers. Difficulties in providing equipment were met by the combined efforts of amateur craftsmen in A.R.P. posts, schoolboys in woodworking classes, W.V.S. sewing and knitting parties—and bright toys soon changed the school atmosphere and produced a delightful nursery air. Stencilled friezes of wonderful design in gay colours shut out the heavy tones of a dreary outside world; inviting rest hammocks with cosy rugs appeared ; accommodation for personal hygiene was provided or multiplied ; miniature towels, toothbrushes and bright pinafores made their appearance ; in other rooms dainty tables and small chairs with crockery and gaily coloured cloths were installed.

The ideal nursery school is a place of great delight. The tiny children arrive in charge of mother, father or elder one of the family at 6 a.m. or 8 a.m. A young teacher with the right feminine instincts normally takes over. With quick observation she registers tired or rested, sick or well, washed or unwashed ; outdoor clothes are divested, hands and face washed, personal attention given if needed, and the child is soon absorbed in the inviting atmosphere, losing his self-interest and forgetting his little worries. Later, tables are prepared for breakfast and four little people take their chair to a table, where after a simple grace they are soon enjoying their first meal of the day—a well-balanced, healthful breakfast.

Self-education is a great feature of the nursery training to-day. Careful direction is given, but the temptation to which mothers so often yield to 'do for' and to 'show how' is advisedly resisted. It is not unusual to see a child of three years working with a small hammer and a few nails and, without any outside help, producing a simple toy roughly put together but with a clear indication of achievement which is easily recognized ; it is to the child-mind a real boat or ship complete with mast, or a bomber plane fitted with bomb racks (this is a record of actual observation). Perfection in execution is a far step, but the self-conceived idea, the attempted expression and satisfaction in completion are valuable apperceptive links for the child and valuable guide lines for the teacher. Primitive dolls in cradles or beds, gardens and hen coops indicate other lines of interest, while on one occasion a child revealed that its chief delight was in producing coffins with tiny bodies rolled out in plasticine lying therein. When the play period is ended, the morning milk, cod liver oil or fruit juice is given, according to nurse's directions, to each child, and a period of restful attention to teacher's talk provides a physical relaxation as a counterpart to the engagement of the mental faculties. Time for lunch soon arrives and training in personal hygiene precedes the meal. The older children of four and five years are very quickly trained to help in serving and assisting the younger members of the community, showing good examples in table manners to the less advanced. The lunch is balanced on dietetic principles by the medical officer and his staff, cooked by a trained woman, and is designed to give all the nourishment required at the proper age. After the lunch, while the children have a period of free play, with toys indoors, or in the sunshine out of doors, the rest hammocks are disposed on the floor and tired little heads and hands are soon resting on them. Even here the teacher's watchful eye must be on the alert. Restlessness must be carefully noted and investigations made which may result in the temporary attention of the teacher or in the calling of a nurse or even a doctor. Much can be learned of a child's temperament and condition by a careful observation of its resting period.

Observation of the child's play interest and activities is a most valuable index to the understanding teacher of his moral and mental tendencies and his growing character. Stimulation or discouragement at the right moment may help to attain the proper balance which results in a normal social attitude.

The importance of early training in regular personal habits cannot be over-estimated. The instincts of the primitive peoples are sometimes reflected in child behaviour. The wolfing of food at irregular times, attacks on weaker children which seem sometimes to have no object but subjugation, the acquisition of coveted toys by force, the destructive craze, or the satisfaction resulting from obvious discomfort in others, are examples of under-developed and uneducated reaction. Careful training in proper behaviour and regular habits with a view to the comfort and happiness of the community is an aim of nursery school life. Self-control is induced by insisting on the proper time for personal hygiene. This may have far-reaching consequences and provide a sound basis for character formation which will react to

the individual and communal benefit in later years. From the point of view of physical health, conditions in war-time nurseries are more propitious to sound development than those in 90 per cent of the homes from which the children are drawn. The balanced diet; the opportunity for fresh air and play; regulated sleep; the use of educational toys; the advantage of communal interests and choice of companionship; the opportunity for free expression in the choice of toys are all advantages which could not be supplied in the great majority of the homes from which the children have come.

The teacher who is suitable for nursery school work has special qualifications natural to her character. With a good educational background she develops the capacity to make herself understood by small children. Her voice is gentle and clear. If she has imagination she can make the nursery stories live so that they will remain as an influence with the young minds long after school days. The ability to draw, with a good sense of colour, to play simple nursery songs and to sing lullabies is a very desirable addition to her qualifications. Above all, she should be healthy with a developing maternal instinct of her own, finding its early expression in a communal way and giving sympathetic understanding and love to the children under her care. In the last two years there has been great competition to enter colleges for nursery school work, and this should have made it possible for the most suitable young people to be selected. It is therefore a well-founded hope that future years will provide a sufficient staff of the right quality for the nursery schools which we hope to see in abundance in a post-war period. At the moment the teaching staff of war-time nurseries is deplorably inadequate. A considerable proportion of it consists of young girls leaving school at the age of fourteen who with a short course of six weeks training have loyally undertaken the responsibility. A large proportion also consists of older mothers whose families are grown up and who may have had little contact with young life in the last twenty-five years. Nevertheless they too have loyally placed their service at the call of the country's need, and the valuable maternal instinct which has been the foundation of a short course of training lasting 4–6 weeks has of necessity had to be their only training for this very responsible and important work.

Records of progress show that physically and mentally the children in these schools have received great benefit, and the contribution to the stamina and resource of the nation cannot be properly assessed at this juncture. It may be, however, that out of this war-time experience will grow a permanent and complete scheme for the proper care of young life.

OBITUARIES

Prof. F. D. Adams, F.R.S.

FRANK DAWSON ADAMS, emeritus Logan professor of geology and vice-principal of McGill University, Montreal, died on December 27 at the age of eighty-three. He was one of the great pioneers in the study of the Precambrian rocks of Canada and in the field of experimental geology. Born in Montreal on September 17, 1859, Adams was educated at McGill University, where he came under the influence of Sir William Dawson, his great predecessor in the Logan chair. After a year of postgraduate study at Yale, he was appointed an assistant on the Geological Survey of Canada: in this service he continued until 1889, when he resigned to become lecturer in geology at McGill University, succeeding to the chair four years later.

Adams's first field investigations were devoted to a study of the character and relations of the large anorthosite bodies lying near the border of the Canadian Shield, north of the St. Lawrence River, within and close to Logan's original Laurentian area. This group of rocks, in places exhibiting a distinct foliation, was supposed by Logan to form a stratified series—his Upper Laurentian—distinct from, and reposing on the Grenville Series. Adams at this time was well equipped for his task—he was a skilled petrographer versed in the new methods of the science, for he had already studied under Rosenbusch—and the detailed mapping he began in 1883 soon brought results of the first importance. He conclusively demonstrated the igneous nature of the partly foliated anorthosites, revealed the aqueous origin of an important group of highly metamorphic garnet gneisses within the Grenville Series and was thus led to a fundamental revision of the classification of the Precambrian in the St. Lawrence area. Some of these results were published as a dissertation at Heidelberg, where he had continued his researches under Rosenbusch during several summer semesters.

Meantime, the epoch-making investigations of A. C. Lawson on the Laurentian succession in the Lake Superior region 800 miles westward had been published, and led Adams, on the completion of his researches in Quebec, to a detailed survey of a large area of the Grenville Series in Eastern Ontario in order to provide a satisfactory knowledge of the Precambrian succession in Eastern Canada. The region selected—the Haliburton-Bancroft area—was geologically almost a *terra incognita*, of which no topographic survey had been made. The field work, in which he was later joined by A. E. Barlow, occupied eight years, the results being published in a memoir in 1910.

These investigations form a classic study on the Canadian Shield and placed Adams in the front rank of petrologists. The phases of metamorphism and varied constitution of the underlying Grenville Series and the character and relations of the succeeding Laurentian granite 'batholiths' were brilliantly demonstrated, while the beautiful maps which accompanied the memoir have furnished the type material for all later discussions on concordant intrusives in folded sediments. Among the more striking petrographic results was the discovery of great bodies of nepheline syenite about the borders of the Laurentian granites. These alkali rocks presented many remarkable variations in composition, and some varieties, being rich in corundum, were afterwards made the basis of an extensive industry for the exploitation of this mineral.

Adams's ripe experience and acknowledged authority in the field of Precambrian research led to his appointment to several international committees to investigate critical localities and to report on the correlation and nomenclature to be adopted for the Precambrian areas on both sides of the Canadian boundary.

The second great field of endeavour in Adams's career was his study of the experimental behaviour of rocks under differential stress. His keen interest

LONDON COUNTY COUNCIL

Applications are invited for appointment to the position of full time Assistant Physicist (temporary war-time appointment) in the Council's hospitals service. The duties will be mainly in connection with X-ray and radium work at Hammersmith Hospital, Ducane Road, W.12, and Lambeth Hospital, Brook Drive, S.E.11, but the person appointed will be required to undertake any other duties which may be allotted to him from time to time. Salary £450 a year rising by annual increments of £25 to £600 a year (together with cost of living addition —at present confined to salaries not exceeding £500 a year—of 7s. 6d. a week for men and 6s. for women). There are no emoluments.

Application forms giving full particulars, obtainable (stamped addressed foolscap envelope necessary) from Medical Officer of Health (S.D.6), 460 Seven Sisters Road, London, N.4, are returnable by February 1, 1943. Canvassing disqualifies.

UNIVERSITY OF LONDON

GRANTS FOR RESEARCH

Applications are invited from members of the University for grants from the Central Research Fund for assisting specific projects of research and for the provision of special material and apparatus. Application forms (which must be returned by March 31, 1943), and further particulars may be obtained from the Academic Registrar, University of London, at 42 Gyles Park, Stanmore, Middlesex.

BRITISH COUNCIL

British Council require Assistant for editorial and general duties in Medical Department. Applicants should preferably have had some experience in abstracting scientific and technical papers, and in the preparation of copy on medical and cognate subjects. Working knowledge of Spanish and Portuguese an advantage. Familiarity with medical terminology essential.

Salary according to qualifications. Send stamped-addressed foolscap envelope for application form to British Council, 3 Hanover Street, London, W.1. Mark envelopes "Medical Department."

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

A Course of six lectures on the ELEMENTARY THEORY OF PROBABILITY IN RELATION TO STATISTICS will be given by Professor H. Levy, in the Huxley Building, Royal College of Science, Exhibition Road, South Kensington, commencing February 17, 1943, at 3 p.m. Application for admission should be made to the Registrar, Imperial College, Prince Consort Road. The fee for the Course is one guinea. Students of the College and Inter-Collegiate students will be admitted free.

PORTSMOUTH MUNICIPAL COLLEGE

Principal: L. B. Benny, M.A.

Applications are invited for a full-time lecturer in BIOLOGY, mainly for BOTANY. A permanent lecturer is required, but a temporary appointment might be made for the war period. Forms of application and particulars of the post may be obtained from the Registrar, Municipal College, Portsmouth.

E. G. BARNARD, M.A.,
Chief Education Officer.

A Manager is required for the transmitting valve division of a well-known company engaged solely on the manufacture of radio valves. Applicants must possess undoubted managerial ability, be qualified engineers, preferably with B.Sc. or equivalent degree and recent experience of transmitting valve development and manufacture, and should be between 30 and 45. This is a responsible post offering excellent prospects both now and after the war. Full details in confidence to Box 902, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Laboratory Assistant (Senior Grade) required for the Chemistry and Biology Departments, Repton School, for the duration of the war. Applications to be sent to T. W. Thompson, The Pastures, Repton, Derbyshire.

Assistant wanted in the Bio-chemical Department for war-duration. Candidates with experience of hospital bio-chemistry preferred. Salary according to qualifications and experience. Applications to be sent to: The Medical Superintendent, Dudley Road Hospital, Birmingham, 18.

Physicist (31) **several years research** experience, wants to change to work in testing or research laboratory of progressive firm. Box 904, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Oxford Nutrition Survey requires experienced Technical Assistant for chemical estimations. Apply in writing to Administrator, 10 Parks Road, Oxford.

Secretarial Service. Specialists in the typing of scientific MSS.—53 Palantine Road, Manchester, 20.

Wanted, for own use, second-hand Vickers Projection Microscope. Please state full details and price to Box 905, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscopes, second-hand, a large selection of instruments in perfect condition; 3d. stamp for list. Chards, Specialists (Est. 70 years), Forest Hill, S.E.23.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this publication should not be taken as an indication that they are necessarily available for export.

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in this department of research was engaged by his long and close observation of the foliated and gneissic rocks of the terrains he had mapped and by the realization that light on this subject might be revealed by experiment in which the factors of pressure, temperature and solution were separated, and the part played by each investigated, first independently, and then in combination. In this work he had the great advantage of collaboration with his engineering colleagues at McGill, first of Nicolson, later of Coker, while his financial resources were supplemented by a grant from the Carnegie Institution. Their results are set down in a remarkable series of publications dealing with the experimental flow of rocks (1901), the elastic constants of rocks (1906), the flow of marble (1910) and an experimental investigation on the depth of the zone of flow in the earth's crust (1912, 1917).

Formerly, almost the only quantitative data on the mechanical behaviour of rocks had been obtained by crushing cubes of rock in a testing machine according to the ordinary rules of engineering practice. Adams's experiments clearly demonstrated that rocks change their character when a confining pressure is applied so that they are no longer brittle but behave plastically. He was able to show that the structures presented by the deformed rocks matched some of those seen among crystalline schists, that the plastic flow of marble in his experiments was associated with gliding or twinning of calcite, unaccompanied, even at the elevated temperatures used or in the presence of water, by re-crystallization, and that in order to develop flow within the crust a rock must be subjected to differential stress which is much, often many times, greater than that sufficient to crush it under ordinary conditions obtaining at the surface.

These experiments had a direct bearing on various problems presented in geophysics—among them the movement of nappes and isostasy—and they have been the first to supply the much needed quantitative data for the study of these and related problems. As such they have formed the pioneer researches in this field of experimental geology, and it is only within recent years that investigation on these lines has been renewed under more closely controlled experimental conditions which advance in technique has permitted.

After his retirement from the Logan chair at McGill, Adams's activities continued unabated. He visited the Far East and spent several field seasons in Burma, Malaya and Ceylon. The most important of his publications during this period was his "Geology of Ceylon" (1929), which presented the first geological map of the island and the first attempt at deciphering its larger structures.

Adams's keen interest in the history of his own chosen field of geology was evinced in many of his early writings. Through the years by diligent search he had gradually acquired a great collection of rare historical texts, and their study served greatly to enrich the scholarly memoir on the "Birth and Development of the Geological Sciences" (1938) which formed the final product of his labours.

During a long and distinguished career, Adams received many honours both in Britain and America. His frequent visits to Great Britain had brought him into close contact with the leading British geologists, and he was a well-known figure at scientific congresses. He was elected a fellow of the Royal Society in 1907 and he was a foreign associate of the U.S. National Academy of Sciences; he served as president of the Geological Society of America (1918), and as the outstanding Canadian geologist of the time was chosen as president of the International Geological Congress which met in Canada in 1913.

C. E. TILLEY.

Mr. F. W. Harbord, C.B.E.

MR. FRANK WILLIAM HARBORD, who died on December 27, at the age of eighty-two, after a long and active career as a metallurgist, was born in Norwich and studied at the Royal School of Mines. After holding posts in iron and steel works in Staffordshire he became consulting metallurgist to the Indian Government, and from 1892 until 1905 he was at the Royal Indian Engineering College at Coopers Hill. In 1905 he took up private consulting practice in London, and the firm of Riley and Harbord (later Riley, Harbord and Law) has always enjoyed a high reputation in the metallurgical world. Although greatly hampered in later years by failing eyesight, he retained his position as senior partner until his death.

Harbord published very few original papers, but he contributed regularly and usefully to the discussions before the Iron and Steel Institute, and his text-book on the "Metallurgy of Steel", in which Mr. John Hall collaborated on the engineering side, reached a seventh edition and long retained its position as the standard English authority on the subject. In his earlier career he published papers on the removal of non-metallic elements from steel in the basic open-hearth process, on nitrogen and arsenic in steel, and on the relations between the properties of steel and its process of manufacture. In 1937 he reviewed very fully the history of the basic Bessemer process, drawing largely on his knowledge of the men connected with its development. The problem of the efficiency of steel works was discussed by him on several occasions.

He was closely associated as a consultant with the development of many new inventions, and in 1903, at the request of the Canadian Government, he reported on the position of electric smelting processes. During the War of 1914–18 he rendered valuable services as honorary metallurgist to the Ministry of Munitions, and at its end was awarded the C.B.E. He was also an officer of the French Legion of Honour.

Harbord took an active interest over many years in the work of the Iron and Steel Institute, being a regular attendant at its Council and committee meetings. He received the Bessemer Medal of the Institute in 1916. His kindly character made him a very popular member.

C. H. DESCH.

WE regret to announce the following deaths:

Dr. George Crile, director of research at the Cleveland Clinic Hospital, of which he was one of the founders, and an honorary fellow of the Royal College of Surgeons, who was known for his work on surgical shock, on January 6, aged seventy-eight.

Sir Arbuthnot Lane, Bt., C.B., the well-known surgeon, on January 16, aged eighty-six.

Sir Henry Maybury, G.B.E., K.C.M.G., C.B., president in 1933 of the Institution of Civil Engineers, on January 7, aged seventy-eight years.

NEWS and VIEWS

Lister Institute of Preventive Medicine

Sir John Ledingham, C.M.G., F.R.S.

SIR JOHN LEDINGHAM, who will retire from the directorship of the Lister Institute of Preventive Medicine at the end of next March, has served the Institute for thirty-seven years, during which he has come to occupy a leading place in bacteriological studies. His wide and detailed knowledge of the literature of bacteriology and immunity and his personal participation and intimate association with many aspects of related research led to his large share in the initiation and production of the Medical Research Council's "System of Bacteriology" in nine volumes (1928–31), which aimed at presenting the British view of the subject. By installing at the Lister Institute the M.R.C. National Collection of Type Cultures, which before the War distributed 5,000–6,000 cultures to all parts of the world annually, and by acting as its director, he greatly furthered the study of bacteriology. In 1907 he began an extensive investigation of carriers of *B. typhosus*, and work on carriers of diphtheria and dysentery bacilli and of the meningococcus was also undertaken in the Department. As the result of detailed studies from 1924 onwards of the skin reaction to intra-dermal inoculation of vaccinia virus, Sir John showed that the elementary bodies described by Paschen in 1906, but afterwards rejected by most bacteriologists, were indeed the pathogenic virus, and were derived from the intracellular inclusions (Guarnieri bodies). Sir John was able to concentrate and purify the virus by centrifuging and to obtain an agglutinating serum for the elementary bodies. In his Harben Lectures (1925), he summarized his work and the then known facts concerning natural immunity, the carrier problem and the variola group of diseases.

In 1932, Sir John Ledingham turned his attention to the causal agent of pleuro-pneumonia of cattle and pointed out that this so-called virus was quite unlike the true viruses, such as those of vaccinia and foot-and-mouth disease, etc. Although filterable in certain stages, its growth on culture media and its varied forms showed that it belonged to a special group, of which the microbe of Agalactia of sheep and the symbiont occurring in cultures of *Streptobacillus moniliformis* were members, as well as certain pathogens from the lungs of rats and some saprophytic forms found in sewage. During Sir John's directorship, the Serum Department at Elstree and the Biochemical Department in co-operation have devoted much time to the selection and purification of bacteriological antigens for use as prophylactic vaccines and for the immunization of horses, and considerable improvements have resulted, especially in dealing with sporing anaerobes, the meningococcus and *B. typhosus*.

In 1935 a Department of Biophysics was opened at Chelsea and a high-speed centrifuge reaching 60,000 r.p.m., an equilibrium centrifuge and an electrophoresis apparatus, all designed by Prof. The Svedberg, were equipped by the generosity of the Rockefeller Foundation. By these means the constituent factors of sera and other mixtures of proteins have been separated and examined and the elementary bodies of several viruses concentrated and purified. Other physical problems connected with the freezing and drying of these substances have also been attacked. Among other lines of research in which Sir John and the bacteriological staff have been specially interested have been phagocytosis, tularæmia, the diffusion factor in wounds, and the connexion between purpura and blood platelets. The Departments of Protozoology, Endocrinology, Biochemistry and Nutrition have continued research work with great activity. The last has been particularly occupied with the standards of vitamins and the fundamentals of war-time diets.

Dr. A. N. Drury, F.R.S.

DR. ALAN NIGEL DRURY, who is to succeed Sir John Ledingham as director of the Lister Institute of Preventive Medicine on April 1, is a distinguished research worker in the field of experimental pathology. In its widest sense that term would, of course, include all the experimental studies of the mechanisms of infection and immunity which have attracted so large a part of the attention of research workers in pathology. Such studies must always provide an important part of the experimental foundations of preventive medicine, and many of the investigations which Sir John Ledingham has made and directed have been of this nature. There is another very important section of experimental pathology which focuses attention on the abnormalities of bodily function produced by diseases, whether these are due to infections or to other causes. Dr. Drury is one of the relatively few in Great Britain who have made the advancement of knowledge in this field of morbid physiology the chief object of their activities in research; and he has used to that end his opportunities of research in the clinic as well as in the laboratory.

Dr. Drury had begun research work at Cambridge, as George Henry Lewes student, in 1914. At the outbreak of war he left for St. Thomas's Hospital to complete his medical course, and having qualified, worked with the R.A.M.C. in India, becoming D.A.D.M.S. (Sanitary) on the Headquarters Staff. After the War he resumed, under the Medical Research Council, an association with Sir Thomas Lewis, begun early in the War, and worked with him from 1921 until 1927 on the action of the heart in health and disease, being particularly concerned with the mechanism of fibrillation and flutter of the auricles. After a temporary spell of ill-health he returned to Cambridge, becoming Huddersfield lecturer in special pathology, and remaining a member of the Medical Research Council research staff. From 1928 onwards, and until the outbreak of the present War, he was again called into organization—this time of war researches for the Medical Research Council. He was engaged in a series of important researches, largely concerned with abnormal functions of the heart and circulation. With Dr. L. J. Harris he discovered the bradycardia produced by defect of vitamin B_1 (aneurin), and with A. Szent-Györgyi he identified a hitherto unrecognized series of circulatory depressants in adenylic acid and related derivatives. Other researches led to the probable identification of a surface-active brain constituent which combines with tetanus toxin, and demonstrated the cardiac hypertrophy resulting from the formation of an arterio-venous anastomosis. Like his distinguished predecessors at the Lister Institute, Dr. Drury may be trusted to encourage and promote researches in the general field of preventive medicine, widely beyond the range of his own direct activities as an investigator.

Colonial Products Research Council

THE Colonial Office has appointed a Colonial Products Research Council, under the chairmanship of Lord Hankey. Unlike the Colonial Research Committee under Lord Hailey, the Council will be an executive body. It will consider what Colonial raw materials may be made of value for the manufacture of intermediate and other products required by industry, and it will initiate and supervise researches, both pure and applied, on such products, and generally consider how by the application of research greater use can be made of them. In framing its programme the Council will have as its principal objective the promotion of the welfare and prosperity of Colonial peoples, and will endeavour also to increase the Colonial contribution to the welfare and prosperity of the British Empire and of the world as a whole. In carrying out its programme, the Council will co-operate with existing institutes, such as the Department of Scientific and Industrial Research, the Medical Research Council, and the Agricultural Research Council, to the greatest possible extent, and will 'farm out' work to these and other bodies by arrangement; it will set up facilities of its own only for work which cannot be done by other means. So long as the war continues, the investigations which the Council will be able to undertake will necessarily be limited.

The Council is composed as follows: Mr. Eric Barnard, director of food investigation, Department of Scientific and Industrial Research; Capt. G. L. M. Clauson, assistant Under-Secretary of State, Colonial Office; Mr. Aneurin Davies; Dr. J. J. Fox, Government chemist; Prof. W. N. Haworth, professor of chemistry, University of Birmingham; Sir Harry Lindsay, director of the Imperial Institute; Sir Edward Mellanby, secretary, Medical Research Council; Sir Robert Robinson, Waynflete professor of chemistry, University of Oxford; Mr. G. W. Thomson, president, National Federation of Professional Workers; and Dr. W. W. C. Topley, secretary, Agricultural Research Council. Prof. J. L. Simonsen, lately of the University College of North Wales, has been appointed director of research. Certain members of the Council are also members of the Colonial Research Committee, and the Council will work in close touch with that body. It will be financed out of the provision for research in the Colonial Development and Welfare Act.

A Photographic Record of the Linnean Collections

THE value of the Linnean collections of animals and plants and of the associated books and manuscripts needs no emphasis. They must always remain of supreme importance to systematists, and the Linnean Society of London has very rightly regarded them as its own special charge. In April 1939 the collections were moved for safety to Woburn Abbey in Bedfordshire, and with the advent of bombing raids in 1940 the Linnean Society, through its Council, took steps for preserving a photographic record of the collections. A generous grant of about £2,000 was made to the Society by the Carnegie Corporation of America for this purpose and the work took active shape in the latter half of 1941. In order to facilitate the work the collections were removed in July of that year to the Zoological Museum at Tring, formerly the property of Lord Rothschild and now a department of the British Museum (Natural History). It was decided to adopt photographs on 35-mm. microfilm and, by this means, it was estimated that it would be possible to make a complete record of all the specimens, books and manuscripts in the course of about nine months. In addition, this would allow of a copy of the finished film being sent to the United States and possibly others elsewhere. As an indication of the extent of the task it may be pointed out that the estimated number of exposures in the case of the plants was 14,000, for the insects 5,000, for the shells 2,000, for the fishes 158, and for the books and manuscripts 30,000—making altogether more than 60,000 exposures. Good progress has been made, and it is probable that the whole of the work will be completed well within the estimated period. The details of the steps taken and how the various difficulties were encountered, together with the services rendered by various specialists, are recounted in an article on the subject by J. R. Norman in the *Proceedings of the Linnean Society* for 1941–42 (Part 1, pp. 49–57).

Investigations in Afghanistan

MR. K. DE B. CODRINGTON has recently returned from Afghanistan. He joined Josef Hackin, director of the French Archæological Mission, in the spring of 1940 and was present during his last season's work at Begram, the site north of Kabul which has produced such remarkable finds. M. Hackin left Kabul in the autumn of 1940 to join General de Gaulle's staff in London, and later lost his life at sea. Mr. Codrington interested himself in the Afghan Government's recent adoption of Pushto as the national language, and wrote an introductory grammar of Kandahari Pushto in collaboration with Colonel Muhammad Yaqub Khan. He speaks warmly of the Afghan Government's interest in archæology and history, and of the work of the staff of the Kabul Museum and the Kabul Literary Society, who are engaged upon a national history. Through the kindness of H.R.H. Sardar Naim Khan, the Minister of Education, and of H.R.H. Shah Mahmud, the Minister of National Defence, Mr. Codrington was able to make collections of flowering plants and varieties of wheat. He also contributed specimens of fishes to the Zoological Survey of India. Certain specimens of Afghan wheat are already being grown at Cambridge, and it is hoped to carry this work further, with the assistance of the Afghan authorities.

Vitamin Production in the U.S.S.R.

AT a Conference of Biochemists held in Moscow last November, attention was directed to the possibilities of utilizing the extensive walnut forests of Kazakhstan as an almost inexhaustible source of vitamin C. The unripe walnut contains an unusual quantity of ascorbic acid, and vitamin C is already being manufactured from it on a commercial scale. It is hoped that the systematic exploitation of the walnut forests for vitamin C production will be fully organized this year. Many hospitals in northern districts successfully use an infusion of pine needles as a means of supplying vitamin C. Other measures adopted since the War for increasing supplies of vitamins include the production of yeast (as well as protein) from food waste, the manufacture of vitamin B_6 from tobacco waste, and the utilization of certain freshwater fish as sources of vitamin D.

The Bed-Bug

ECONOMIC Series No. 5 of the British Museum (Natural History) is an illustrated brochure entitled "The Bed-bug: its Habits and Life-History and how to deal with it" (5th edition, 1942), by A. W. McKenny Hughes and C. G. Johnson. This insect, at the present time, is very prevalent in the larger cities wherein many areas are heavily infested. Large-scale evacuation of the population has resulted in the creature becoming established in wide areas previously uninfested. After the War it is likely that further redistribution of large numbers of people will again be necessary. Many complaints have come to hand about public shelters and similar places where people congregate during air-raids being infested. It is obtainable, price 6*d*., from the Museum or through a bookseller.

Some Problems in Transmission-Line Design

IN a paper with this title read in London on December 9 before the Institution of Electrical Engineers, Mr. A. Burke gives particulars of some of the serious damage caused by snowstorms to electrical transmission lines in Ireland, and of consequent departures from conventional design. The factors governing the examination of breakdown data are analysed critically and the data and conclusions for particular cases are stated briefly. Loadings are compared with those specified by the British Regulations for Overhead Lines, and the effectiveness of the universal method of controlling the factor of safety of conductors is challenged. The superiority of a horizontal over a triangular arrangement of conductors is viewed from a new angle and the reasons for adopting a horizontal arrangement on wood poles for 260 miles of 110 kV. line are given. Various problems in connexion with the design of this line are set out, costs are given and the conclusion is drawn that it is much more economical than a line carried on lattice steel towers.

Journal of the Society of Glass Technology

THE general adoption some years ago of the glass bottle for the delivery of milk to the household brought about a wide realization of the importance of glass in everyday life. A war-time shortage of metal has led to many replacements of metal-can by bottle. There is therefore much of general interest scattered through each number of the *Journal of the Society of Glass Technology*. The latest issue, vol. 26, No. 116, includes a fully illustrated paper on "Cords, Surface Condition and Quality of Glassware", as well as more than sixty pages of abstracts. The *Journal* is issued bi-monthly from the University of Sheffield, Northumberland Road, Sheffield, 10.

Recent Earthquakes

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of two recent earthquakes. The first was on November 10 at 11h. 41·3m. U.T. and the provisional epicentre was latitude 35° E., longitude 46·5° S. This is in the bed of the ocean somewhat to the west of Prince Edward Island to the south of Africa. The second earthquake was on November 12 at 4h. 55·4m. U.T. and its provisional epicentre at latitude 16·8° N., longitude 94·2° W. This is in the high country to the east of Chimalapa in the Isthmus of Tehuantepec in Central America.

Comet Whipple

THIS comet is now a naked-eye object and has been observed in various parts of Great Britain. A new orbit has been computed by Dr. M. Davidson from observations extending over a much longer period than those which were used for the preliminary orbit given in NATURE of January 9, p. 51, and is more accurate than the earlier orbit. The comet will probably remain a naked-eye object for some time and will continue to move northwards until February 25, after which its declination will slowly decrease.

Orbit

T	1943 Feb. 7·00 U.T.	
ω	40·0°	1943·0
Ω	100·1	
i	19·9	
q	1·354	

Ephemeris

Date 1943	R.A. h. m.	Dec.	ρ	r
Feb. 1	10 31·3	+49·7°	0·436	1·357
5	50·8	51·7	·442	·354
9	11 07·4	53·3	·452	·354
13	21·3	54·2	·465	·357
17	35·8	55·0	·479	·362
21	50·2	55·4	·495	·370
25	12 00·6	55·5	·513	·380

Announcements

PROF. JOHN ALFRED RYLE, regius professor of physic in the University of Cambridge, and physician extraordinary to the King, has been elected professor of social medicine in the University of Oxford.

THE Committee of the Athenæum has elected the following, under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, or the arts, or for their public services: Prof. Emile Cammaerts, professor of Belgian studies and institutions in the University of London; Admiral Sir Andrew Cunningham; Prof. W. N. Haworth, professor of chemistry in the University of Birmingham.

THE People's Commissar for Education in the U.S.S.R. has instituted fifteen valuable Newton scholarships for Soviet university students. They are to be awarded to young men and women specializing in physics, mathematics, mechanics and astronomy. The Universities of Leningrad and Moscow will receive three scholarships each. Other Newton celebrations include exhibitions of portraits and books in English, Russian and other languages on Newton at the University of Moscow and the Scientists' Club.

A WEEK-END course on February 27 and 28 on factory medical services and industrial diseases for medical practitioners has been arranged at the London School of Hygiene and Tropical Medicine. The course will be opened by Sir Wilfred Garrett, chief inspector of factories, at 2 p.m. on February 27. The subjects of succeeding lectures are: industrial diseases of the lungs; skin lesions arising from coal distillation; the investigation of toxic hazards; a method of assessment of physical requirements for processes with reference to routine medical examinations; industrial fracture; and recent work on antiseptics. Applications to attend, with a fee of one guinea, must reach the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, not later than February 22.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Penicillamine, a Characteristic Degradation Product of Penicillin

WE noticed more than nine months ago that acid hydrolysates of penicillin gave a strong blue-violet coloration with the ninhydrin reagent. Afterwards it was found that, under standardized conditions of hydrolysis, the colour intensity given by numerous penicillin preparations of varying degrees of purity ran parallel to their antibacterial activities except in the case of very crude specimens. It was also found that about 59 per cent of the total nitrogen of the purest preparations could be estimated as amino-nitrogen after one hour's hydrolysis by means of *N*/10 sulphuric acid under the conditions of the van Slyke method. These facts indicated that the substance responsible for the ninhydrin reaction and the positive results in the van Slyke amino-nitrogen determinations was a fundamental part of the penicillin molecule. Its isolation was therefore regarded as a matter of importance and we are now able to report that it has been obtained as a crystalline hydrochloride. The properties of this substance, which we propose to term *penicillamine*, show that it represents a novel type of naturally occurring base. Penicillamine is identical with the base which we have stated in an earlier communication[1] to occur in acid penicillin hydrolysates.

Penicillamine is obtained by hydrolysing barium penicillin (both 650 and 1,000 units/mgm. have been employed) at 100° C. for one hour by means of *N*/10 sulphuric acid, and the base is eventually precipitated from a concentrated solution by mercuric chloride. After de-mercurizing by hydrogen sulphide and evaporation of the solution at the room temperature under diminished pressure, a mass of homogeneous needles is obtained (yield, 30–40 per cent calc. on nitrogen content of penicillin). Analysis (Weiler and Strauss) of material dried *in vacuo* at 50° (loss, $1H_2O$) gave the formula $C_6H_{11}O_4N,HCl$; just conceivably $C_6H_9O_3N,HCl,H_2O$, although the salt did not lose water at 100° in a high vacuum. The molecular weight determined by X-ray crystallographic measurements (private communication by Crowfoot and Low) was in satisfactory agreement with the formulæ $C_6H_{11}O_4N,HCl,H_2O$ or $C_6H_9O_3N,HCl,2H_2O$. It is worthy of note that $C_6H_{11}O_4N$ is $C_6H_{12}O_6 + NH_3 - 2H_2O$.

Penicillamine appears to be optically inactive (19 mgm. in 1·3 c.c. of water) and we take this opportunity of correcting the statement that barium penicillin of 500 units/mgm. is lævo-rotatory; the substance is dextro-rotatory in aqueous solution. The electrometric titration curve of the new base shows the presence of three proton-binding centres, at *p*H 2·0, *p*H 7·9 and *p*H 10·5, respectively. These may be an acidic hydroxyl, the basic group, and a weakly acidic hydroxyl group. The nitrogen is present in an amino-group and is liberated (more than 90 per cent) as nitrogen with nitrous acid in five minutes under the conditions of the van Slyke method. The ninhydrin reaction is an intense bluish-purple coloration.

Other properties of penicillamine, however, are very different from those of the known amino-acids and even suggest a relation to an amino-sugar and ascorbic acid, optical inactivity in that event being due to racemization through enols. Naturally these unusual properties (see below) may be due to substituent groups and do not certainly exclude the presence of a carboxyl group. A typical α-amino-acid structure is rendered improbable by the slow and incomplete formation of carbon dioxide on heating with ninhydrin[2] at *p*H 2·5 (0·2 mol. in ½ hr., 0·3 mol. in 1 hr.; glutamic acid gave 0·95 mol. carbon dioxide in 12 min. under similar conditions). Penicillamine gives a deep blue coloration with ferric chloride which quickly fades owing to oxidation. It reduces ammoniacal silver nitrate on gentle warming and gives a green colour with Fehling's solution. It reduces iodine in cold acid solution, taking up rather more than two atoms of iodine. The change appears to be reversible; for example, the colourless solution renders iodine to ether. This experiment suggests oxidation of a hydroxy-enolic or amino-enolic system or N-iodination. On heating a solution of penicillamine and *p*-nitrophenylhydrazine in *N* hydrochloric acid at 100°, glyoxal-*p*-nitrophenylosazone is produced in about 20 per cent yield. This degradation indicates the source of glyoxal-*p*-nitrophenylosazone obtained in much earlier experiments when penicillin was heated in *N* acid in the presence of *p*-nitrophenylhydrazine. The natural explanation is that a glycollaldehyde fragment has been detached, but it should be observed that fission with formation of formaldehyde would also supply an explanation of this result[3]. In either case the reaction represents an unusual type of decomposition.

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[1] NATURE, **149**, 356 (1942).
[2] van Slyke, Dillon, Macfadyen and Hamilton, *J. Biol. Chem.*, **141**, 627 (1942).
[3] Cf. Pechmann, *Ber.*, **30**, 2460 (1897); **31**, 2123 (1898).

Increase in Toxicity of Stilbamidine Solution on Exposure to Light

THE increasing use of stilbamidine (4:4′-diamidinostilbene di-β-hydroxyethane-sulphonate) for treatment of kala-azar in the Sudan[1] and India[2] makes the properties of this drug a matter of some importance. Kirk[3] reported that solutions of the drug which had been made up and exposed to light for some time appeared to have increased in toxicity. Fulton and Yorke[4] have confirmed this suggestion experimentally, and our own work, carried out independently as a result of Kirk's observations, has given similar results. Dilute solutions of stilbamidine (0·5 per cent), exposed to sunlight, increase in toxicity four- or five-fold in about four days, after which there is no appreciable further increase. Weak solutions (0·5 per cent) change much more rapidly than do stronger, but by subjecting 10 per cent solutions to the light from a mercury arc lamp for several hours, we have been able to prepare sufficient quantities of toxic solution for isolation of the material responsible for this toxicity.

The toxic diamidine is readily separated from unchanged stilbamidine by precipitating the latter as its sparingly soluble hydrochloride with excess hydrochloric acid. From the filtrate the toxic amidine is precipitated by excess caustic soda as a gum from which the hydrochloride and sulphate have been prepared in pure crystalline condition. Other well-defined salts include the picrate and picrolonate.

The product is almost certainly 4 : 4′-diamidino phenyl benzyl carbinol, but rigorous proof is difficult. This diamidine on heating loses water and ammonia to give *trans* 4 : 4′-dicyano stilbene. At one stage it was thought that the toxic product was *cis*-4 : 4′-diamidinostilbene, but this on heating yields cis-4 : 4′-dicyanostilbene. The different picrates obtained from the two amidines also indicated that this theory was incorrect. On hydrolysis the amidine obtained by irradiation gives an acid, which from analysis appears to be phenyl-benzyl-carbinol-4 : 4′-dicarboxylic acid; this acid, on successive treatment with thionyl chloride and *o*-toluidine, yields a toluidide identical with that obtained from stilbene dicarboxylic acid similarly prepared.

The toxic product and its derivatives are thus readily converted back to the corresponding stilbene derivatives. The toxic amidine is colourless and exhibits only a slight fluorescence in ultra-violet light, whereas '*cis*-stilbamidine' exhibits an initial weak fluorescence which is intensified in a few seconds until comparable with that of the *trans*-compound.

It seems probable that the reaction occurring in aqueous solution is an addition of the elements of water to the double bond of the stilbene linkage. It is possible that the function of the ultra-violet light is first to convert some of the trans-stilbene to the cis-compound, which is the more reactive form.

It follows from the above, and the fact that other therapeutic diamidines have shown no such alteration in biological or chemical properties, that the change is associated solely with the unsaturated stilbene linkage, and that the amidine groups are not affected.

The biological results obtained with the isolated and purified toxic diamidine are in conformity with those of the exposed solutions. The symptoms produced in mice by the toxic substance were more stimulant in character than those caused by a freshly prepared solution of stilbamidine, which were mainly depressant. In general, the pharmacological effects shown by the toxic product differed quantitatively rather than qualitatively from those of the original substance. The depressor action in the anæsthetized cat was increased about five times, and recovery was delayed. Atropine only partially antagonized this effect, while the spleen was actively contracted. Smooth muscle of the rabbit intestine was sometimes contracted in concentrations of about 1 : 50,000, but after atropine, inhibition and relaxation were always produced; this differed from the effect of stilbamidine, which caused contractions which were only slightly reduced after atropine. The fall of pressure was probably mainly due to vasodilatation, since there was no depressant action on the isolated rabbit's heart. The isolated product had a toxicity in mice which was five times greater by intravenous injection, and ten times greater by subcutaneous injection, than stilbamidine. Of great importance was the observation that the toxic product was almost inactive therapeutically against *T. equiperdum*.

There are many interesting features of the phenomenon which we propose to examine at a more favourable opportunity. For example, it is almost certain that at least one other product of irradiation, a yellow compound, is formed in small quantities; the appearance of a yellow colour in the solution is particularly marked in the case of slow irradiation in natural light. We also intend (in view of the findings of Kirk[3]) to see whether prolonged administration of therapeutic doses of the toxic product causes pronounced liver damage.

The nature of the changes occurring on exposure of solutions of stilbamidine emphasizes the necessity for use of freshly prepared solutions of this drug, especially when it is realized that a marked increase in toxicity is apparent after only two or three hours standing in daylight.

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[1] Kirk, R., and Sati, M. H., *Ann. Trop. Med. Parasitol.*, **34**, 83 (1940); **34**, 181 (1940).
[2] Napier, L. E., Sen Gupta, P. C., and Sen, G. N., *Indian Med. Gaz.*, **77**, 321 (1942).
[3] Kirk (private communication; see (4) below).
[4] Fulton, J. D., and Yorke, W., *Ann. Trop. Med. Parasitol.*, **36**, 134 (1942).

Antimony Content and Toxicity of Urea Stibamine

UREA STIBAMINE, introduced by Brahmachari[1] in 1922 and widely employed in the treatment of kala-azar in India and elsewhere, still remains a compound with no definitely known and agreed chemical formula. It was originally reported to be a substance composed of urea and *para*-aminophenylstibinic acid with the empirical formula, $C_7H_{12}O_4N_3Sb$. Later it was suggested that the compound was identical with ammonium-*para*-carbamidophenylstibinate, $NH_2.CO.NH.C_6H_4.SbO(OH).ONH_4$[2]. Ghosh *et al.*[3] and Gray *et al.*[4] gave definite evidence that urea stibamine was not a single substance of definite composition and the latter group of workers showed that the 'effective active principle' was a di-substituted urea, *S*-diphenyl-carbamide-4 : 4 distibinic acid. The antimony content of various commercial samples was shown by Ghosh *et al.* to vary between 20 and 43 per cent, while Gray *et al.* reported a comparatively smaller range of variation in antimony content from 44·19 to 48·6 per cent. Brahmachari[5] appeared to have accepted the results of Gray *et al.* in this regard, and emphasized that the divergent results obtained by different investigators were due to different brands of "so-called urea stibamine", not conforming to his original specifications, being put on the Indian market.

In connexion with the routine testing of drugs on behalf of the Director-General, Indian Medical Service, this laboratory had an opportunity, during the years 1940–42, of testing more than a hundred samples (with different batch numbers) of urea stibamine manufactured by the Brahmachari Research Institute, Calcutta. Chemical assay for antimony content (Ghosh[6]), and toxicity tests (Burn[7]) on white mice were regularly carried out. In a few specimens, survival time of infected mice (*T. equiperdum*) was also recorded according to the method of Gray *et al.* (*loc. cit.*).

A critical analysis of our data shows that, in general conformity with the findings of Gray *et al.*, the antimony content of urea stibamines (Brahmachari[1]) is fairly constant and lies between 39 and 42 per cent. In only five instances (out of 100 analyses) was a figure above 42 per cent (but less than 44) found. In only one case, a figure below 39 per cent antimony was obtained. However, our maximum figure was definitely *lower* than the minimum figure (44·19 per cent) of Gray *et al.*[4].

Napier[8] found that the lethal dose of urea stibamine for mice was 250 mgm. per kgm. body weight. Though an accurate statistical analysis of our mean lethal dose figures has not yet been made, it is possible to state that in the majority of our experiments a toxicity figure varying between 200 and 225 mgm./kgm. was recorded. The maximum tolerated dose was often in the neighbourhood of 150 mgm./kgm. and seldom exceeded 170 mgm./kgm. Specimens containing a higher antimony content apparently showed a higher toxicity and stronger therapeutic effect, but a statistically significant relationship between antimony content and toxicity could not be established.

Work is in progress to find out whether, in view of its fairly constant composition (within the limits stated above), urea stibamine can be employed as a *standard* for evaluating the potency of other pentavalent organic antimony compounds of similar composition manufactured in India. The absence of an international standard of unvarying composition for antimony, as in the case of organometallic compounds of the arsenic group, is keenly felt by workers engaged in drug standardization in India.

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[1] Brahmachari, *Ind. J. Med. Res.*, **10**, 492 (1922).
[2] Niyogi, *J. Ind. Chem. Soc.*, **5**, 753 (1928).
[3] Ghosh *et al.*, *Ind. J. Med. Res.*, **16**, 461 (1928).
[4] Gray *et al.*, *Proc. Roy. Soc.*, B, **108**, 54 (1931).
[5] Brahmachari, NATURE, **145**, 1021 (1940); **145**, 546 (1940).
[6] Ghosh, *Ind. J. Med. Res.*, **16**, 457 (1928).
[7] Burn, "Biological Standardization", 252 (1937).
[8] Napier, "Kala-azar", 2nd Edit. (London, 1927).

Configuration of Purine Nucleosides

HENDRICKS[1] has measured the interplanar cleavage spacings, *d* (001), of a number of organic salts of the clay mineral montmorillonite by means of nickel $K\alpha$ radiation. Among the cations studied were those of the purine bases guanine and adenine and the corresponding nucleosides guanosine and adenosine, which are 9-guanine *d*-ribofuranoside and 9-adenine *d*-ribofuranoside respectively[2]. By his measurements Hendricks showed that the arrangement of the atoms of the two purine ions is coplanar, thus confirming the view which is reached from consideration of molecular models. He also concluded that the nucleoside ions have a van der Waals 'thickness' between oxygen centres (of montmorillonite) only about 1·0 A. greater than would be required for a strictly coplanar atomic arrangement, and that the purine and sugar radicals of the nucleoside ions lie in two parallel planes about 1·5 A. apart, with the majority of the atoms lying probably in or near the two planes; one plane contains the purine radical, the other the ribose ring, and it is held that the hydroxyl groups as well as the primary alcohol group must be approximately in the plane of the purine radical, in order to accommodate this close lateral packing of atoms.

Hendricks thus postulates that in the nucleoside montmorillonites the hydroxyl groups at C_2 and C_3 of the pentofuranoside and the primary alcohol group C_5 are in the *cis* relationship with reference to the plane of the furanose ring, whereas in the ribofuranosides the configuration is such that the hydroxyl groups are both *trans* to C_5; in fact, the sugar shown in Fig. 8a[1] is not a ribofuranoside but is a lyxofuranoside. Nevertheless it is generally accepted that the sugar in these nucleosides is *d*-ribose, and further proof of this identification will shortly be published elsewhere in so far as the pentose of the four nucleotides of the ribonucleic acid of yeast is concerned. Nucleotides from other sources are being similarly examined.

Consequently, there would seem to be two alternatives. (1) The sugar in the nucleoside ions examined was actually *d*-ribose; if so, the conclusions of Hendricks may require revision to accommodate the fact that either two hydroxyls or one primary alcohol group, depending on the as yet unsettled α- or β-configuration of the glycosidic linkage, will lie outside the plane of the furanoside ring, *trans* to the purine radical and at a distance from the furanose plane about the same as that separating it from the purine plane. (2) The sugar in the nucleoside ions examined was in fact α-lyxose; in this case the position would be that the pentose in the nucleosides (nucleotides) may not always be *d*-ribose, a possibility which we have suspected for some time. In this connexion it may be mentioned that two of us have isolated *l*-lyxose in the form of a derivative from yeast ribonucleic acid; the details and significance of this observation will be discussed elsewhere. The material source of the nucleosides examined by Hendricks was not stated.

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[1] *J. Phys. Chem.*, **45**, 65 (1941).
[2] See Gulland, *J. Chem. Soc.*, 1722 (1938).

Newt Larvæ in Brackish Water

IT is generally believed that amphibian larvæ are not found in salt or brackish waters, and therefore the following observation seems interesting.

On August 7, 1942, newt larvæ were observed in one pool of the many on the western side of Carradale Bay, Argyll. The pool was about nineteen yards from the nearest salt water pool on a gently sloping shore. Its bottom consisted of rock and shingle and it was surrounded by turf. It was fed by rain and seepage. A sample taken contained chloride equivalent to 0·28 per cent sea water. This is regarded as a fresh water.

On August 18 a neap tide came to within nine yards of the pool. During the night of August 18–19

there was a considerable wind, and judging from the line of jetsam the sea had reached this pool, which had increased in size. It was measured roughly on August 20. It was L-shaped round the base of a large rock. The long arm of the L, parallel to the sea, was about 20 ft., and the short arm, directed landward, 10 ft. long. It was less than 4 ft. wide and the greatest depth was less than 3 ft.

The water was visibly layered. A sample from the shallower parts contained 5·6 per cent sea water and from the bottom of the deep parts 68·3 per cent sea water. The newts congregated in the lower levels of the shallower parts, but occasionally swam through the deep water. Thirteen newts lived twenty-four hours in the 5·6 per cent sample, but one newt put into the 68·3 per cent died within 1 hour 40 minutes. On August 20, after rain in the night, no dead newts were seen in the pool and a further sample of unanalysed shallow water was taken and added to the 5·6 per cent sample. The newts lived in this until August 22, when it was diluted with the 0·28 per cent sample.

One larva metamorphosed and left the water on August 26, and others did so in the next few days. Therefore the newts seem to have completed their larval development in conditions in which the salinity could rise considerably.

I think there were between 100 and 200 larvæ in the pool. They were of many different sizes.

According to the taxonomic tables of Werner and Herter in "Fauna von Deutschland", edited by P. Brohmer, the larvæ were of *Molge palmata*.

The only other common animal in the pool was a species of Gammarus which did not avoid the salter layers. According to the criteria of Chevreux and Fage, "Faune de France", **9**, and of Stephenson, "Tierwelt der Nord und Ostsee", **10f**, the species was *duebeni*, but the taxonomy of this genus is still fluid.

I wish to thank Mr. J. B. Cragg of the School of Agriculture, University College of North Wales, Bangor, for analysing my samples.

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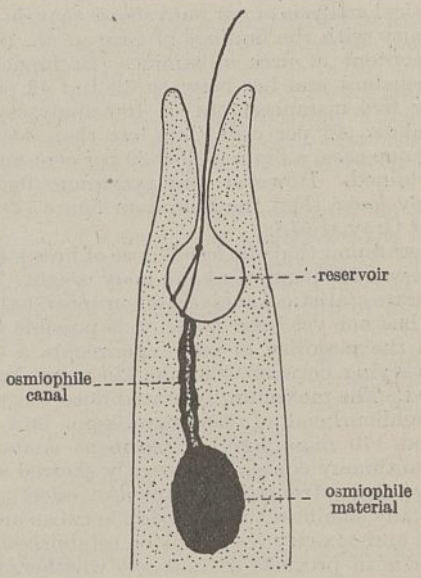
Golgi Apparatus in *Astasia Harrisii*

IT is well known that in numerous Protozoa, the contractile vacuole is associated with an osmiophile cortex, which is believed to be homologous with the Golgi apparatus of metazoan cells. In Paramecium, it has been shown by Nassonow[1] that the secretory canals leading into the contractile vacuoles are osmiophilic in nature, and are considered to represent the Golgi apparatus in this form. Although many Protozoa possess similar canalicular systems, canals with osmiophile walls have never since been demonstrated in any other Protozoon, although a great number have been investigated.

By making Golgi preparations of *Astasia Harrisii* (Pringsheim), a euglenoid flagellate, using the usual Weigl technique for Protozoa[2], I have shown that such an osmiophile canal is present in this organism. It runs from the base of the reservoir, ending in a large mass of osmiophile material approximately spherical in form.



Its general morphology is very similar to that of a single canal of Paramecium, being globulated throughout its length, and is evidently concerned with secretion or excretion into the reservoir.

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Jan. 2.

[1] Nassonow, D., *Arch. Mikr. Anat.*, **103** (1924).
[2] Gatenby, J. B., and Smyth, J. D., *Quart. J. Micro. Sci.*, **81** (1940).

The Encephalophone: a New Method for Investigating Electro-Encephalographic Potentials

THE usual methods for investigating electro-encephalographic potentials consist in applying the amplified potentials from the head either to a directly recording oscillograph or to a cathode ray oscillograph with photographic recording. The permanent records thus obtained are of value for the purpose of research into the physiological and pathological functioning of the brain, and the results of such researches are becoming of definite clinical value. We wish to suggest a new apparatus for use in the clinical application of electro-encephalography as distinct from the application to research, where recording instruments are essential; it is meant, at its present stage, merely as an auxiliary to the established methods.

The principle of the suggested method is to convert the potential changes from the head into changes of pitch of a musical tone. In an instrument constructed by us, this tone is produced by two independent high-frequency valve oscillators of slightly different frequencies of the order of 5 mc./sec. These are 'mixed' by means of a mixer valve, thus producing

a beat frequency equal to the difference between the two high-frequencies. If this beat frequency is in the audio range, it can be made audible as a tone of certain pitch in a loud speaker or pair of earphones. One of the two high-frequency oscillator circuits is connected to a 'frequency modulator' valve which acts in such a way that a change of the control-grid potential of this valve produces a change in frequency of the oscillator to which it is attached. This results in an alteration of the beat frequency and thus in a change of pitch of the tone heard. The potentials from the head are amplified in the usual way by means of a linear amplifier designed for very low frequencies, before applying them to the frequency modulator valve. We propose to call this instrument an 'encephalophone', following a suggestion by Dr. George Dawson.

The instrument has been tried out and found to work very satisfactorily. Both 'alpha' rhythms and 'beta' rhythms give characteristic trills, while the three per second and other slow waves usually met with under pathological conditions produce correspondingly slow sweeps of tone which are very striking and readily appreciated. There seems little doubt that the method is adequate for most diagnostic purposes to which the graphic method has so far been successfully applied. Further, there are some distinct advantages of the audio method over the present graphic ones. The apparatus, consisting of valves, batteries, etc., can be built in one compact unit, which is very inexpensive and easily portable. Secondly, in the audio method the observer's visual system is left free to watch for the slight movements of the subject's body which produce artefacts in the electro-encephalic potentials; this is of especial value in the examination of non-co-operative subjects.

As a possible future development, the two ears of the observer might be used for two 'channels'. The inputs to these two channels could be taken from symmetrical regions in the two hemispheres of the head, and it is probable that a departure from symmetry in frequency or size of rhythm, or even in phase, could be detected in this way. The observation of phase-relationships in any two regions could also readily be undertaken by the audio method employing two channels.

Our thanks are due to the University of Edinburgh, to the Rockefeller Foundation and to Mr. Norman Dott for the opportunity of doing this work.

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The Eclipse of the Sun in A.D. 45

ON the few occasions when eclipses of the sun are stated to have been predicted in ancient history, it has generally been found that these took place in the afternoon and could have been predicted as recurrences of the eclipses seen in the morning eighteen years earlier. This argument cannot be applied to the eclipse of August 1, A.D. 45, which certainly took place in the morning at Rome. It could not have been predicted from the eclipse of July 22, A.D. 27, which was not visible in any part of Europe. The assertion is that the Emperor Claudius issued a proclamation stating that the eclipse was expected, with full explanations, so that it should be regarded as a natural event and neither a prodigy nor a bad omen. Both the Emperor and his scientific adviser must have been quite certain of their facts, because they could not take any risk of failure.

I am not aware that anyone has investigated this eclipse before me, and I was rather surprised and impressed when my calculations led to the result that it took place in the morning. It must be inferred that the knowledge of astronomers at that time concerning the eighteen-year period was something more than the simple and elementary ideas usually ascribed to them. They must have understood that eclipses inevitably recur at these intervals, although they may be visible only in distant parts of the earth. If they really knew that after three such periods the eclipse must reappear in its former locality, we have to believe that they had some knowledge of the dimensions of the earth and of that which we now call longitude.

At Rome the maximum phase was at 10.36 a.m., local mean time, and the magnitude thereof was 0·35 of the sun's diameter. The central line, where the eclipse was total, passed a long way south of Italy, far down in Africa. As to who the learned man who coached the Emperor may have been, I would suggest that while there was a frequent service of shipping between Ostia and Alexandria, bringing grain to Rome, it would be easy to communicate with the astronomical fraternity in Egypt, as Julius Cæsar actually did, when requiring advice on the subject of reforming the calendar, a century before Claudius.

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Sir Henry Miers

SHOULD it not be recalled that Sir Henry Miers gave the clue for the discovery of terrestrial helium? In 1868, Norman Lockyer, founder and first editor of NATURE, observed in the spectrum of a solar prominence the characteristic yellow line of helium, previously unknown. In 1888, Dr. Hillebrand, of Washington, discovered that the mineral uraninite treated with sulphuric acid gave a gas which he suspected to be nitrogen. On the discovery of argon in 1895 by Rayleigh and Ramsay, search was made for sources of nitrogen, and Miers suggested to Ramsay examination of the gas discovered by Hillebrand. Ramsay sent a sample to Crookes for spectroscopic analysis: Crookes said "This is helium".

Last year, I congratulated Miers on his long innings, suggesting that he could survey his Agar's Plough with satisfaction and that in giving the clue for the discovery of helium, he hit the ball over the pavilion. "Oh, no!" he replied with characteristic modesty, "the helium episode is only a timid but lucky swipe which happened to sneak through to the boundary." In another letter he declared, "I don't really care two straws about credit for what was really a fluke".

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RESEARCH ITEMS

Avian Phylogeny

As the result of detailed anatomical investigations, more especially into the flexor carpi ulnaris, flexor sublimis digitorum and other muscles in the struthious birds and the Tinamous, Percy R. Lowe (*Proc. Zool. Soc. Lond.*, B, 112; 1942) has come to certain general conclusions regarding the relationships of these groups to the rest of the birds (the Neognathæ). The author states that his findings do not favour the view, associated particularly with the names of Fürbringer and Gadow, that the various groups of struthious birds have evolved independently, but on the contrary they are to be regarded as a more closely knit group. Moreover, it is not possible to regard them as having arisen from a volant stock that has become modified owing to the loss of the power of flight. Among other things, the sternum ossifies from two centres one on each side related to the fused ends of the ribs, and there is no sign of the median Lophosteon from which the keel of the sternum of the carinate birds develops. Nor is neoteny, as de Beer suggested, an explanation of the conditions found in struthious birds, for the arrangement of the muscles bears practically no resemblance to those of the chick in any flying bird; it is on an altogether lower plane and gives no indication of an ancestral power of flight or the possibility of the development of such a power in the adult. The tinamous (Crypturi) also are to be looked upon as Palæognaths, but volant types where the attempt at flying was more successful than in other types, and even at that not so successful as in the case of the characteristic carinate birds. While the bones in the palate of Hesporornis are not satisfactorily established, the author suggests they are probably to be regarded as aquatic Palæognaths.

Nephridia of Earthworms

To zoologists whose knowledge of the excretory system of the Oligochæta is based upon the condition in Lumbricus it may come as somewhat of a surprise to learn that the terminal portion of the nephridium, the bladder, is not present in a number of genera. It is still more surprising to learn of the great variety of form and arrangement of the nephridia that are to be found within the limits of the group; indeed they are more variable than any other organs. Two main types are to be recognized, which Bahl has termed exonephric and enteronephric types; the former opening directly or by means of a longitudinal, common duct to the outside and the latter opening by means of ducts into the lumen of the gut. K. N. Bahl (*Quart. J. Micro. Sci.*, **83**, Pts. III and IV; 1942) has provided a description of the nephridia in the sub-family Octochætinæ, and this is prefaced by a useful review of the various types of nephridia encountered in the Oligochæta and also some details as to their development. The same author in the same journal has a second paper dealing with the multiple funnels in the nephridia of *Thamnodrilus crassus*, *Hoplochætella bifoveata* and *Lampito* (*Megascolex*) *mauritii*, which form an interesting, graded series.

British Species of Ephemeroptera or Mayflies

SCIENTIFIC Publication No. 7 of the Freshwater Biological Association of the British Empire is entitled "Keys to the British Species of Ephemeroptera with keys to the Genera of the Nymphs", by D. E. Kimmins, Dept. of Entomology, British Museum (Natural History), 1942. The appearance of this well-illustrated pamphlet will be welcomed by entomologists and others, since it provides for the first time a reliable means of identifying these insects. It should stimulate their collecting and observations so that an accurate idea may be obtained regarding the distribution of the different species. Altogether forty-seven species are claimed as being British, but there is no doubt that intensive collecting and observation will bring to light others in the future. Knowledge of the nymphs or immature mayflies is as yet insufficient to enable satisfactory keys to be devised for the determination of the various species. It is for this reason that a key to the identification of the genera only is provided. Most species of mayflies occur in Britain, under suitable conditions, in enormous numbers, and in all stages of their life-cycle they form a very important constituent of the food of freshwater fishes. This and other publications of the Association are free to members of that body. To non-members it is obtainable from the Director, Freshwater Biological Association, Wray Castle, Ambleside, Westmorland, price 2*s*. 6*d*. Membership of this body, it may be added, is open to any who sympathize with its objects, the minimum annual subscription being £1.

Oxidation of Ascorbic Acid in Tea

DURING an inquiry into the suitability of certain articles of food as carriers of ascorbic acid, it was found that condensed milk, to which synthetic ascorbic acid had been added, lost its antiscorbutic activity when mixed with tea. In their efforts to prevent this destruction, G. A. Snow and S. S. Zilva (*Biochem. J.*, **36**, 641; 1942) established that inactivation of the ascorbic acid was due to the presence of certain non-metallic organic compounds, associated with the tannin fraction, capable of catalysing the oxidation of ascorbic acid in the presence of oxygen. Commercial gallic acid showed some activity, whereas *d*-catechin, tannic acid catechol, quinol and pyrogallol were almost inactive. Milk, egg albumen, cysteine and to some extent dimedone, inhibited the catalytic activity, and sodium chloride and potassium iodide accelerated it. Substances of a similar catalytic nature may be present in other vegetables and fruit tissues either originally or after treatments such as cooking or drying. For example, aqueous acetone extracts of the root and stem of rhubarb, and aqueous infusions of the dried leaves of rhubarb and camellia were active. Should the presence or formation of these catalytic substances in vegetables and fruits be fairly common, it would add one more factor to those which have to be considered in connexion with the stability of vitamin C in vegetables and fruits.

Comparative Morphology of the Algæ

NUMEROUS cases are reported of parallel development among algæ; in this connexion stress is usually laid mainly on the simpler types of plant body, but F. E. Fritsch now directs attention to the very wide occurrence of the heterotrichous habit among those algal groups which have attained a higher degree of specialization than the simple filament (*Ann. Bot.*, N.S., 6, No. 23; July 1942). Though exhibited in many algal groups, this habit is perhaps of most interest to follow in the Phæophyceæ and Florideæ; here the heterotrichous condition

appears as the adult form or as a juvenile condition in the Ectocarpales and Nemalionales, but the prostrate system tends to become reduced and finally to disappear in the most specialized members of the groups (for example, Ceramiales), but persists in intermediate groups, especially in the gametophyte. The filamentous stages of some of the larger Ectocarpales, derived from spores from plurilocular sporangia on the sporophytes (plethysmothalli), seem best explained as sporophytes arrested for a considerable time in the heterotrichous, juvenile condition and distinct from the filamentous gametophytes derived from spores from unilocular sporangia. Cutleria, which is exceptional among algæ in showing alternation of two different macroscopic phases, shows, in intermediate forms which are described, evidence of origin from a heterotrichous type, in which the sexual generation has lost the prostrate, and the asexual the erect, part of the system, though traces of the latter persist as the column which is formed early in the development of the 'Aglaozonia' stage sporophytes.

Factors in the Production of Leaf Palisade Tissue

A VERY interesting contribution to our knowledge of this subject is made by R. W. Watson (*New Phyto.*, 41 (3), October 1942). Using cuttings of the juvenile form of ivy, it was possible to initiate the production of palisade in fully expanded leaf blades by transferring them from a shaded to a brightly lit habitat. If transfer was sudden the layer of mesophyll cells immediately below the upper epidermis, with the exception of those nearest to the veins, might be killed, evidently through desiccation. A more gradual or less violent adjustment of light was shown first by an accumulation of starch, then in the upper cell layers starch disappeared with a growing concentration of sugar in the cells, and this was followed by water absorption and an increase in length at right angles to the leaf surface as characteristic palisade tissue was developed.

Luminosity a Mendelian Character in a Fungus

RUTH MACRAE confirms (*Canad. J. Res.*, 20(8), August 1942) previous observations that whereas the mycelium of *Panus stypticus* in Europe is non-luminous the North American form is luminous. Both forms are heterothallic and all pairings between monosporous mycelia from the two forms seem to be fertile. It has thus been possible to show, by crossing luminous and non-luminous forms, that this is an inherited character governed by a single pair of Mendelian characters and that luminosity is dominant and is expressed as a dominant character in the binucleate mycelium in the *F*1 generation.

Systems with Boron Trifluoride

THE boron atom of BF_3 acts as an acceptor of electrons to form a large number of co-ordinate compounds. Atoms which act as donors of electrons are carbon, nitrogen, oxygen, fluorine, phosphorus, sulphur and argon. H. S. Booth and D. R. Martin (*J. Amer. Chem. Soc.*, 64, 2198 ; 1942) find that HCl and CH_3Cl give only eutectics and no compounds with BF_3, so that the reported compound BF_3,3HCl is non-existent. Nitrous oxide N_2O forms no compound with BF_3. Sulphur dioxide SO_2, as in the case of solvents H_2O and NH_3, forms a compound BF_3,SO_2 and two eutectics. The structure suggested is an ionic one $[SO]^{++}[OBF_3]^{--}$ analogous to the monohydrate $H^+[HOBF_3]^-$, although the formula $O_2S \rightarrow BF_3$ is also possible and would agree with the formation of the compound $H_2S \rightarrow BF_3$.

X-Ray Elasticity Measurements for Mild Steel in Compression

THE X-ray study of elastic properties of metals is continued in a paper by S. L. Smith and W. A. Wood (*Proc. Roy. Soc.*, A, 181, 72 ; 1942). Mild steel specimens were used in a standard 10-ton testing machine, and the X-ray tube was built up alongside in a position suitable for taking back-reflexion photographs. The external strain measured by an extensometer was compared with the changes in diameter of a sensitive X-ray diffraction ring formed by back-reflexion of beams incident perpendicular to the length of the specimen and to the direction of stress. It is concluded that the lattice possesses a yield point also in compression, again marking the onset of a permanent lattice strain. The direction of this strain is opposite to that found in tension and the magnitude increases systematically with the applied stress. Experiments on pure iron suggest that the mechanics of the metallic lattice involve the principle that, after the lattice yield point, in a given direction the lattice systematically assumes a permanent strain in such a sense as to oppose the elastic strain induced by the applied stress.

Abrasion Test for Textile Threads

A. C. WALKER, writing on this subject (*Bell Lab. Rec.*, 21, No. 1 ; September 1942), refers to studies made in the Bell Laboratories on the resistance to abrasion of threads of different materials such as are used for the braided covering of telephone cords, and of treatments to improve the life of the braids. One test is carried out by an abrasion apparatus which wears threads or braids until they break, the time required serving as a measure of wearing qualities. Threads tied in endless loops are suspended from hooks fastened to a stationary cross-bar. Square weights are hung from the loops and the threads are then arranged about staggered pins mounted on a movable plate, being looped around the middle pin so that they twist together in a sharply bent loop. As the movable plate oscillates up and down under the action of a motor-driven cam, it rubs the threads against each other and wears them at the sharp bend. It is important to have two threads in parallel to minimize the tendency of the single strands to twist and untwist during the rubbing action. The threads are prevented from twisting about one another by resting the square weight lightly against a backing plate. The cabinet which encloses the apparatus is air-conditioned for controlled humidity and temperature. Seventeen samples can be tested at a time. One of the chief limitations to the reproducibility of results attainable in testing textiles is the lack of uniformity in the materials. In measuring the abrasion resistances of spun mercerized cotton used for telephone cord braids, the method described gave consistent results within $\pm$ 15 per cent of the average for groups of seventeen samples. This is considerably better than might be expected on the basis of the variability in the spun yarn, as shown by analyses of the results of several hundred tests. Because the time required to test threads is short compared to testing finished cords, this method lends itself to rapid preliminary studies for improving wearing qualities.

AGRICULTURAL EDUCATION ASSOCIATION

ANNUAL CONFERENCE

IT was quite evident from the attendance at the Midland Agricultural College during January 4–6 that the Council's decision to resume the normal conferences was a popular one, for some seventy-five members arrived to take part in the discussions. Two years ago it had been decided to suspend most of the activities of the Association because of difficulties consequent upon numerous members being drafted from their usual activities into the service of war agricultural executive committees, to the disorganization of agricultural colleges and university departments due to changes in policy thrust upon them in the early days of the War, transport difficulties and so on. But as time went on, it became obvious that the multitudinous problems now besetting the agricultural scientist and educationist would have to be discussed by as many people as possible, and the recent conference was the outcome of the demand.

Prof. R. G. White, University College of North Wales, Bangor, presided at the two paper-reading sessions. It is not possible to do more than indicate the general lines of the more important matters discussed, but the papers presented will be published in full in the Association's journal *Agricultural Progress*. The discussion which took place upon agricultural education in rural areas is not included in this brief summary, but will receive special attention in another issue of NATURE.

Three papers of outstanding value dealt respectively with drainage, seeds and milk. On the subject of drainage, Mr. H. H. Nicholson, of the School of Agriculture, Cambridge, dispelled any feelings of complacency there might be in various quarters by stating that we are not draining agricultural land in Britain very much faster than we were during the period 1864–72; at that time some 44,000 acres annually were being intensively 'tile drained', whereas now, at a time when we are fighting for our lives on the agricultural front, only about 124,000 acres have been scheduled in two years, and the drainage could scarcely be called intensive. He complained, too, of the timid approach to mole draining in many counties. Soil conditions for mole draining, he said, are at their best in March, April, May and June, when the surface is firm enough to allow easy passage of implements and the subsoil is moist enough for the mole to function properly. He deprecated the warning off of the mole plough during these months simply because the ground is occupied by a straw crop, for in his opinion very little damage would be done to the crop by moling over it. He would like to see more attention being paid to the principles of drainage in agricultural courses at colleges and universities.

The vital question of seed supply in war-time received attention from Mr. L. E. Cook, executive officer to the Seed Production Committee of the Ministry of Agriculture. He showed first that in normal times we receive seeds from all parts of the world and produce only a small amount ourselves. At the outbreak of war, we were cut off from European supplies, while supplies from America and New Zealand and other countries were gravely threatened. To ensure sufficient seeds the Government has had to interfere with the usual trade arrangements whereby individual firms buy where and as they choose, and substitute a system whereby the Government does all the buying in the national interest. Mr. Cook stressed the necessity for looking well ahead when dealing with seeds, saying that the next planting of seeds for seed crops such as mangold, onion, sugar beet will not produce seeds for sowing until 1945, and that from the sowings of cocksfoot in the spring of 1943 a full crop of seed will not be available for use before the spring of 1946. On the home production front, there are now twenty-seven seed growers' associations in existence, and the Government has fixed acreage targets for many kinds of home-produced seeds. The all-important thing is to have a sufficiency of seeds, and this may mean excessive production in a favourable seed-producing year; it is consequently necessary for growers' prices to be safeguarded.

In two closely related papers, Prof. H. D. Kay and Dr. J. G. Davis, of the National Institute for Research in Dairying, explained the National Milk Testing and Advisory Scheme. Prof. Kay described how in the early part of 1942 an advisory committee representative of the Ministries of Agriculture, Food and Health, of the Milk Marketing Board, the National Farmers' Union, the Central Milk Distributive Committee and the County Councils' Association prepared a nation-wide scheme to maintain a satisfactory standard of quality for all milk supplies; to reduce loss of milk from souring; to arrange for unsatisfactory milk to be manufactured or otherwise salvaged, or to be rejected and returned to the producer; to provide a basis for the introduction as soon as possible of a scheme of differential prices to producers in accordance with the keeping quality of the milk, and to provide information to enable county and provincial advisory services to be used to the best advantage. Such a scheme had become urgently needed because of the enormous amount of milk which is being lost every summer in Great Britain through premature souring, a loss which is destroying the efforts being made throughout the country to increase milk production.

Before such a scheme could be put in operation it was necessary to devise some simple and *rapid* test in order to weed out milk that fell below a certain standard. Dr. Davis described how in 1941 a comparison of all the recognized quick tests was completed by a panel of advisory dairy bacteriologists, with the result that the 'ten minute resazurin test' was officially recognized. Prof. Kay claimed that in spite of war-time difficulties and the fact that the whole country has not yet been covered, the scheme is already bearing fruit. Two of its main objects are to improve the standards of the lower 50 per cent of milk producers in Great Britain who have hitherto had little help or advice, and to better the technique of milk handling in the many larger and smaller collecting units where methods are at present unsound. He saw a point of very great significance in that here, probably for the first time in the history of dairying, all sides of the industry and all the Government departments concerned are freely co-operating to achieve a single purpose, the permanent improvement in the keeping quality of the nation's milk supply. A later speaker described this scheme as a perfect example of the application of science to a particular problem—first the examination of the data, then the search for a solution and the testing

thereof, and finally the devising of machinery to apply the solution to the industry as a whole.

Another paper of considerable scientific interest was contributed by Mr. W. Morley Davies, of Harper Adams Agricultural College, who reviewed the present knowledge of crop failures caused by deficiencies of the minor elements in the soil. Such failures have been noticed in very many counties, and although they cannot be regarded at present as of major economic importance in the British Isles, further information concerning them is greatly needed. The commonest deficiency diseases in crops are those due to shortages of manganese, magnesium, boron and iron, and Mr. Davies was able to describe, with the aid of slides in colour, the characteristic symptoms of each disease. When recognized, the first three diseases can be controlled by application of manganese salts, magnesian limestone and borax, respectively. Mr. Davies mentioned that, certainly in the case of manganese and boron deficiency, over-liming tends to accentuate the symptoms, and while it is to be hoped that this statement will not interfere with the liming programme that is so urgently needed in many parts of Great Britain, it must be recognized that in certain circumstances and on certain soils lime is definitely harmful. One complaint caused, not by a deficiency but by an excess of a minor element, is 'teart'. Teart describes the scouring which takes place when cattle are turned out on certain pastures in Somerset, Warwickshire and elsewhere. It has recently been discovered that excess of molybdenum in the herbage of such pastures is responsible for the trouble; dosing the cattle with small amounts of copper sulphate is the remedy.

Wireworm problems were dealt with by Mr. W. E. H. Hodson, of the University of Reading, and Mr. D. J. Finney, of Rothamsted Experimental Station, the latter applying himself more to the statistical examination of data provided by the recent wireworm survey. From these two papers it appears that the present method of sampling fields for wireworms is reasonably accurate; it involves the collection and examination of twenty randomized cores, each 4½ in. in diameter and 6 in. deep, per field (fields of more than 50 acres are treated as two fields). Populations below 300,000 per acre can be disregarded except for maincrop potatoes; populations between 300,000 and 600,000 are dangerously high for many crops; between 600,000 and a million wireworms per acre are likely to be serious, while populations of more than a million render the likelihood of a good crop fairly remote. The speakers did not claim that the wireworm problem has been solved, but much progress has been made. As Mr. Hodson pointed out, the mere knowledge of a high population leads to extra care and extra cultivation, and so there is a better chance of a good crop.

In a summary of the present position of silage-making, Mr. W. McLean, of the University College of North Wales, thought that the actual making of silage demands greater attention than has hitherto been given to it. The results achieved to date indicate clearly that the underlying principles of the modern silage process must be more thoroughly understood by farmers in general before good quality silage can be produced generally. He thought that the 1940 silage campaign had rushed the farmers into an improperly understood operation, and the consequent failures had done the movement much harm.

Speaking on the subject of artificial insemination centres for dairy cows, Dr. S. Bartlett and Dr. J. Edwards said that the advantages of artificial insemination are now widely appreciated, and these are particularly evident in the case of small dairy herds where the keeping of a bull is uneconomic. Two Government-sponsored centres are in existence, at Cambridge and at Reading, and these are expected to yield information of considerable value and to provide pointers for lines of future development. Shorthorn and Friesian bulls are kept at Cambridge, and at Reading there are Guernseys as well. It seems clear that if a high grade of bull is to be kept and proper control of disease is to be maintained, the cost is likely to be of the order of 30*s*. per cow inseminated.

SYNTHETIC TEXTILE RESEARCH IN GERMANY

IN June of last year (1942) orders were given in Germany that scientific workers there and in the occupied countries should confine their activities solely to research that would give immediate practical results. Assuming that there is any real validity in the oft-attempted distinction between fundamental or pure science research on one hand and the immediately useful on the other, it still remains a matter of considerable difficulty to predict whether or no a particular piece of research will yield immediately practical results. The question cannot be pursued here. The main point of interest is that, despite strict orders, the artificial textile research workers in Germany have just expressed their profound conviction that fundamental research, in that particular field at least, is of the utmost importance, and must be pursued, even under war conditions, with greater zeal than ever before. This was the dominating note of the fourth meeting of the Zellwolle- und Kunstseide-Ring at Weimar, and was emphasized by the Government representative himself, Staatsrat Dr. Schieber, in his opening address[1].

The Zellwolle- und Kunstseide-Ring was established a few years ago as a kind of study circle by the leading technical schools and universities in Germany, to the meetings of which leading specialists in the different branches of textile research are invited to read papers and initiate discussion. At this fourth meeting, in September last, it was claimed that much hitherto unpublished work of considerable interest was presented, especially in connexion with cell structure as revealed by the latest methods of electronic investigation.

This latter formed the subject of several papers, beginning with that of Dr. E. S. Schiebold, of the Leipzig school, on the use of the electron microscope for the study of organic molecules of the macromolecular type; followed by Dr. L. Wallner, also of Leipzig, on ultra-microscopic and X-ray work on cellulose structure; and by Dr. F. Gunther, on ultra-microscope studies of the polyamides and polystyrol. On the basis of numerous analyses and calculations of the kind described in these three papers, an attempt has been made to arrive at much more accurate and complete models of cell structure in natural and artificial fibres.

Problems of size, position, and spacing of the individual elements—molecules or molecular groups—especially in the softened or dissolved state, were discussed by Prof. Kratky, of the Kaiser Wilhelm

[1] *Chemiker Zeitung*, **28**, Oct. 1, 1942.

Institute for Physical Chemistry at Dahlem, who had used the so-called small-angle dispersion in his X-ray work.

Probably the greatest name, on the Continent at least, in macromolecular physics and chemistry is that of Dr. H. Staudinger of Freiburg i. Br., who recently completed his three hundredth paper on the subject. At Weimar, he reviewed his work on cellulose and introduced the results of his latest research on the relation between molecular chain-length and strength of fibre in the polyamide group. He referred also to the viscosity of dilute solutions of these products, a matter with which he had previously dealt in considerable detail, under the heading of molecule-colloids. Dr. F. H. Müller, of the University of Leipzig, dealt with specific viscosity in relation to structure in solutions; and Dr. Moll, of Berlin, discussed some differences between ordinary cotton and various artificial *Zellwollen*, and the effect of spinning methods, degree of polymerization, etc., using density measurements of the greatest accuracy. New methods of measuring these various factors were disclosed by Dr. A. Marschall, of the Zehlendorf textile factory, with special reference to the solubilities of various natural and artificial cellulose products.

Other papers dealt with longitudinal swelling of cellulose and *Zellwollen*; relation between degree of swelling and textile properties; treatment of cellulose with formaldehyde and other substances with a view to the introduction into the molecule complex of foreign materials and to so-called bridge-building for controlled modification of properties; and various methods of testing both artificial and natural fibres. No new fibres were introduced, with the exception of a new acetate silk by Dr. A. Sippel, of the Rhodiaseta Works at Freiburg, for which remarkable strength is claimed.

WELFARE OF WAR-WORKERS AND SEAMEN

A REPORT issued by the Ministry of Labour and National Service on "Welfare Outside the Factory and Seamen's Welfare in Port" (Cmd. 6411) gives some account of the work of the Welfare Department of the Ministry, August 1941–August 1942 (London: H.M. Stationery Office, 2*d*. net).

In regard to the transference of war workers to various parts of Great Britain, a 'convoy' system under which, for example, women coming from Scotland to the Midlands meet at Edinburgh or Glasgow and are then brought down in a party overnight in specially reserved compartments, accompanied by officers of the Ministry, and are met at Birmingham by the reception officers, has proved extremely successful. In regard to lodging and billeting, the formation of local advisory committees, including representatives of the local authority, regional officers of the Ministry of Health and Ministry of Labour and National Service, the women's voluntary services and employers and trade unions promises to give good results in difficult areas. Reference is again made to shopping difficulties, to problems of travel to and from work, and to the care of transferred workers during sickness, all of which are receiving attention, as are problems of recreation, entertainment and holidays, while to free mothers for war work, special steps have been taken to see that their children are cared for during working hours.

In regard to seamen's welfare, the provision of hostels has been a major task of the Department, and such hostels have already been provided at Liverpool, Cardiff, Newcastle and Hull, while others are being established at Leith and Glasgow. These Merchant Navy Houses are managed by the National Service Hostels Corporation. Recreational centres with facilities for meals and a drink have been established at Newport and Hull, and others are being established at Swansea and Avonmouth. Health questions are also receiving attention, and the hospitals now make known to the seamen's welfare officer the names of all merchant seamen who have been admitted, to facilitate visiting and the supply of books, periodicals, etc.

FORTHCOMING EVENTS

(*Meeting marked with an asterisk is open to the public.*)

Saturday, January 23

CHEMICAL SOCIETY (in the Chemistry Lecture Theatre, University College, Shakespeare Street, Nottingham), at 3 p.m.—Dr. R. A. Morton: "Vitamin-*A*".

Monday, January 25

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Mrs. Reginald Wyndham: "Java, Sumatra, Celebes, Flores and Bali" (Kodachrome and other films).

Tuesday, January 26

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. M. J. Field: "Some Aspects of Indirect Rule".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Sir Lawrence Bragg, F.R.S.: "The Solid State", (i) "Atomic Architecture".*

Wednesday, January 27

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. S. Russell: "Trawling and the Stocks of Fish".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. K. S. Sandford: "The Geology of Northern French Africa".

Saturday, January 30—Sunday, January 31

ASSOCIATION OF SCIENTIFIC WORKERS (at Caxton Hall, Westminster, London, S.W.1). Conference on "Planning of Science, in War and in Peace" (to be opened by Sir Robert Watson-Watt, F.R.S.).

APPOINTMENTS VACANT

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

LECTURER IN PHYSICS AND MATHEMATICS at the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (January 29).

LECTURER IN ELECTRICAL ENGINEERING at the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (February 6).

CHAIR OF MINING—The Secretary, The University, Edmund Street, Birmingham, 3 (March 1).

SENIOR PHYSICS MASTER—The Headmaster, Ellesmere College, Ellesmere, Shropshire.

ASSISTANT HORTICULTURAL OFFICER—The Chief Executive Officer, War Agricultural Executive Committee, The Deanery, Worcester.

TEACHER (MAN OR WOMAN) OF MATHEMATICS, PLUS PHYSICS AND/OR CHEMISTRY—The Headmaster, The School, Dartington Hall, Totnes, Devon.

LABORATORY STEWARD for the Sierra Leone Government Medical Department—The Secretary, Overseas Manpower Committee (Ref. 624), Ministry of Labour and National Service, Hanway House, Red Lion Square, London, W.C.1.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

UFAW: the Universities Federation for Animal Welfare. Sixteenth Annual Report, Year ending September 30, 1942. Pp. 4. (London: Universities Federation for Animal Welfare.) [71

Medical Research Council: Nerve Injuries Committee. Aids to the Investigation of Peripheral Nerve Injuries. (M.R.C. War Memorandum No. 7.) Pp. 48. (London: H.M. Stationery Office.) 2*s*. net. [81

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