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Vol. 158, No. 4021

SATURDAY, NOVEMBER 23, 1946

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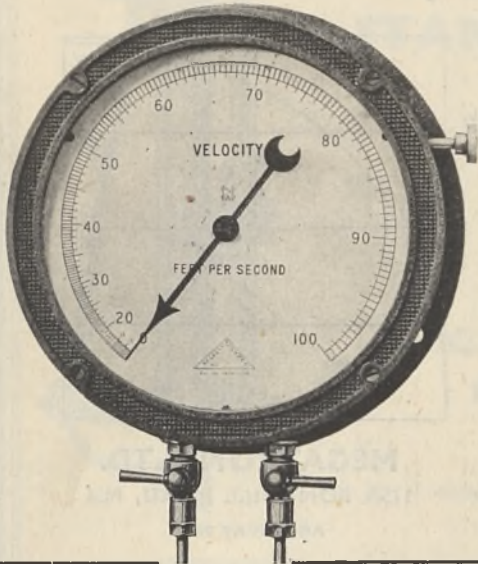


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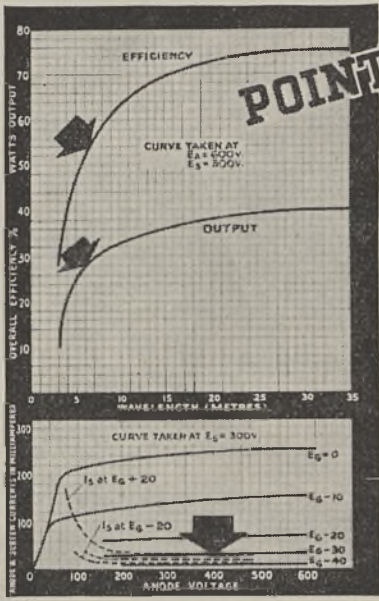
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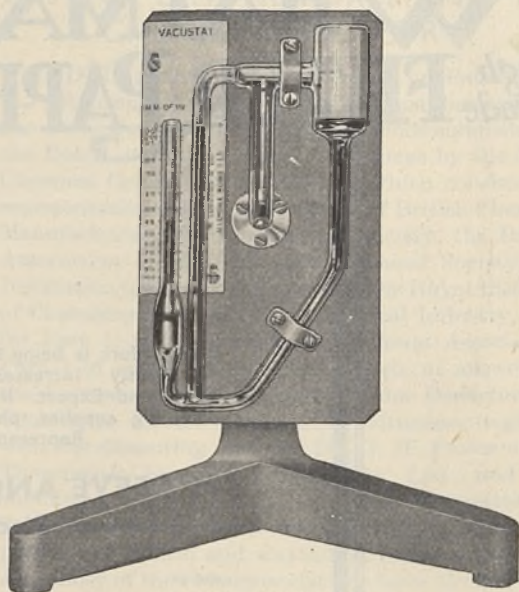
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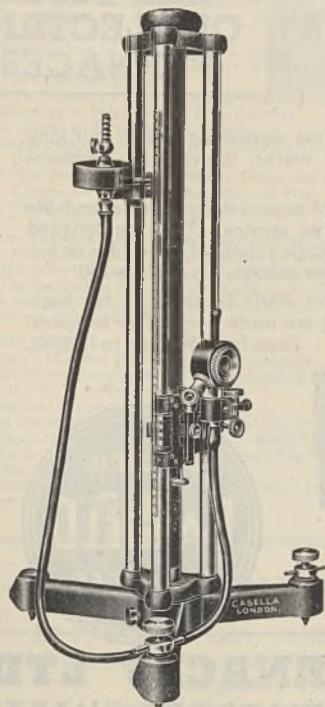
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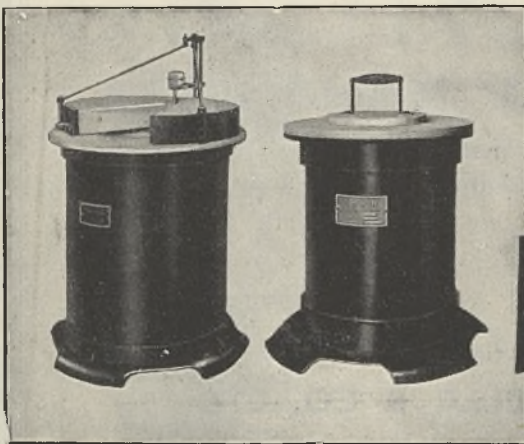
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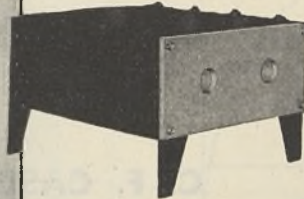
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PATENT LAW REFORM AND THE CHEMICAL INDUSTRY*

UNDER the title "Memorandum on Patent Law Reform" there have now been published under one cover Parts 1 and 2 of the evidence submitted to the Board of Trade Patents Committee by the Joint Chemical Committee on Patents, which consisted of representatives of the Association of British Chemical Manufacturers, the Biochemical Society, the British Association of Chemists, the Chemical Society, the Institution of Chemical Engineers, the Royal Institute of Chemistry, the Society of Chemical Industry, and, for Part 1, the Wholesale Drug Trade Association. Part 1 of this Memorandum consists of answers to the fourteen questions issued by the Departmental Committee for the guidance of witnesses, together with the dissenting views of Dr. G. H. Fraser of the Therapeutic Research Corporation, Ltd., and was submitted to the Board of Trade Committee in September 1944. Part 2 covers the wider aspects of patent law reform and was submitted in June 1946. A number of the recommendations have already been adopted in the Second Interim Report of the Departmental Committee which was discussed in *Nature* of July 6, p. 1.

Like the Board of Trade Committee, the Joint Chemical Committee believes that the abuses of patent monopoly by the suppression of inventions so often charged against patentees in the popular Press are usually found on examination either to be non-existent or to be due to the abuse of the power of wealth; and in its view, the remedy lies in refusing grant of invalid patents, strengthening Section 27 of the Acts intended to provide a remedy against abuse, and considerable reduction in the costs of a successful defendant in the Patents Court. The endorsement of all patents as 'licences of right' either on grant or after three years is not recommended; but it is recommended that the Comptroller-General of Patents should have power to refuse a patent for lack of subject-matter on the further statutory grounds that the invention is not a manner of manufacture or otherwise of industrial significance, and that it does not contribute to the art any item of new knowledge.

This question of subject-matter is discussed more fully in Part 2, where the criteria are expressed in three short definitions. An invention, in order to have subject-matter, must be based upon a discovery. A discovery is the contribution of some item of new knowledge to the art. An item of knowledge is new if it is not ascertainable from the prior art, that is, is not to be found described in the prior art and is not deducible by a strictly syllogistic process of reasoning from data to be found in the prior art. Definition of patentable subject-matter in the Act in these terms is recommended, and further that an applicant should be required to set out in his complete specification a statement of the discovery upon which his invention is based; when validity is

* Memorandum on Patent Law Reform, by Joint Chemical Committee. Pp. 118. (London: Association of British Chemical Manufacturers, 1946.)



challenged, however, he should be entitled to plead any new knowledge, expressed or implicit, which is contained in the description of his invention in the specification.

The Committee then proceeds to discuss selection patents or 'invention by selection' on the lines of the well-known judgment of Mr. Justice Maugham revoking three patents of the I. G. Farbenindustrie A.G., and recommends that a definition substantially in accordance with that judgment, and including a rule based on a recent decision of Mr. Justice Evershed sitting as Patents Appeal Tribunal on Dreyfus Application 542034, be incorporated in the Patents Act. An inventor must bring himself within the rules for selection if there is a prior disclosure or claim of his invention which is not merely a statement of desiderata but prescribes, though only in general terms, the substances, agencies, or means by which his invention is effected. In these circumstances the requirements for patentability as a selection from the general disclosure or claim are discovery of a previously unrecognized advantage shown by the selection and not common in the field of the general disclosure or claim, and limitation to a manufacture based on that discovery. In addition, there must be novelty (the selected members must not have been specifically mentioned before) and adequate description of the invention, that is, of the advantage which justifies the selection.

The Memorandum next suggests that the scope of product claims should be defined as protecting the product, when made by the process described or by any process which is non-inventive over it, thus bringing chemical inventions into line with other inventions. For 'chemical process' is suggested the definition: "a process in which a product is formed by a re-arrangement or re-distribution of atoms of chemical elements present in the starting materials, or by intra-atomic change". 'Chemical invention' means an invention involving as an essential for its operation a chemical process. The Memorandum also outlines a scheme for Empire patents, but recognizes the inherent difficulties of such an arrangement. Various modifications of opposition procedure are proposed, including notification of anticipations without formal opposition, filing of an agreed "Technology of the Case", limitation of evidence to statements of facts and exclusion of argument, and limited extensions of time for filing evidence. As new grounds for opposition it is proposed there should be added: (i) that the invention involved no discovery (as defined) over published knowledge, and (ii) that the invention had been made available to the public by prior uses amounting to publication.

Freedom of amendment within the scope of the original disclosure is also suggested. Amendments which enlarge the claims (always within the scope of the original description) should be allowed, subject to third-party rights, a new definition of which is proposed. The Memorandum deals at some length with the terms and conditions of licences, distinguishing between patent licences and patent assignments, and recommends that both should always be registered, and the terms and conditions disclosed to

the Comptroller-General of Patents, who should have power to open them to public inspection where he finds illegal conditions imposed. The sanction of an infringement action should not be available for terms and conditions which are essentially of the nature of a trade agreement, and the patentee should not be allowed to assert rights which extend beyond those granted by the Letters Patent.

These proposals should put a stop to many abuses of monopoly, and to the use of patents to impose a system of private commercial law.

Inclusion in the Act of a new section setting out the rights and obligations of a patentee is also recommended. The miscellaneous proposals include a general right of appeal from all decisions of the Comptroller, companies to be entitled to be sole applicants for patents, extension of provisional rights by post-dating up to six months, list of Patent Office citations to be printed at the end of a specification, printing of refused specifications with the consent of the applicant, and correspondence with patent agents to be privileged. The reprinting or photographic reproduction of out-of-print specifications, abridgments, indexes and reports of patent cases to be undertaken as soon as possible, and all printed specifications to be kept in print for fifty years after their date, are other recommendations which will be of interest to many outside as well as inside the chemical industry.

SUPERNATURAL OMNIBUS

Witchcraft and Black Magic

By Montague Summers. Pp. 228 + 16 plates. (London: Rider and Co., Ltd., 1946.) 28s. net.

IT will be news to many that "the Cult of Satan, still enthusiastically recruiting in every land, has enormously increased even within the last five and twenty years". All the more reason for a historical and scientific demonstration of this thesis. The writer of this book deprecates the "few freakish and facile pens" and the "books made of paste and scissors" which have dealt with it already; but he does not seem to realize how nearly his own pages come into this condemnation. Though he quotes several of the well-known collections of material in his introduction, he seldom gives 'chapter and verse' for his statements, and is content, for example (p. 16), with the *Daily Telegraph's* account of "a much-talked-of case", in April 1934, when what is expected is at least a reference to the *Law Reports*: similarly, "a recent writer 1929" is insufficient authority for a dictum about "white witchcraft". No one doubts (p. 27) that Blackstone ("Commentaries", 4, 60; 1765) wrote that "to deny the possibility, nay, the actual existence of witchcraft and sorcery is at once flatly to contradict the revealed word of God", and quoted "examples" and "prohibitory laws" which "at least suppose the possibility of a commerce with evil spirits"; that John Wesley ("Journal", 1768) rather quaintly wrote that "the giving up of witchcraft is in effect giving up the Bible"; that Dean Inge (p. 24), preaching in 1932, had "not the slightest doubt that Christians are enjoined to believe in a positive, malignant, spiritual power"; or that Dr. Heywood, Bishop of Ely, on June 23, 1938, com-

menting on late frosts, thought that "discarnate rebellious spirits may have some temporary and limited power to exercise evil influences in the realm of Nature as they apparently have in the realm of humanity": a belief which the author of this book supports (p. 32), and devotes himself to substantiate. His "Supernatural Omnibus" is in its twentieth thousand. The older witnesses cannot be cross-examined now; but what we want to know is documented experimental detail about "one of the best known figures in the University of Oxford not much more than ten years ago", who "was commonly believed to entertain a familiar", and had a spare shadow which vanished if he passed St. Aloysius's or Blackfriars (p. 48). What happened at St. Mary's or the Friends' Meeting House? We look for evidence, likewise, about "Polstead, Suffolk, a district notoriously infested by witches" (p. 49); about Mother Redcap of Horseheath, Cambs., who died in 1926 (*Sunday Chronicle*, Sept. 9, 1928); or the "famous Paris clairvoyante" (name suppressed), whose familiar "St. Gabriel" foretold a fire at a bazaar (p. 103). Egyptian magic is only illustrated (pp. 109-110) from the British Museum's mummy No. 22542, with the comment that "it is a grievous and a very terrible thing that an exhibition of mummies and mummy-cases is permitted".

Continuity between older and recent practices is confirmed by reported discoveries of formulæ from the *Petit Albert*, and copies of magical books, in the hands of persons sentenced in Jamaica for witchcraft (pp. 127-28), and for similar offences in England (pp. 131-32). But beliefs and practices are not substantiated because they are old.

In the case of François Courteon (pp. 155-159) published in 1794, the author begins to put forward his own hypothesis. He quotes from the *Daily Express* in January 1934 a case of 'overlooking' in Dorset, and multiplies it by "scores that remain unknown" (p. 163). He quotes "the Press" in December 1934 for the existence of four active "occult magic circles" in London (p. 180), and he skins recent books on the Obeah cult in Jamaica, which he attributes to "that false god, Satan, the prince of hell" (p. 191). The cat is now out of the bag, and the rest of the book, though more explicit, is no better documented, and need not detain us. For a *Templum Palladicum* discovered in Rome in 1895 no reference is given at all (p. 209).

Frankly, this book is of the 'paste-and-scissors' quality which its author professes to deplore: it leaves witchcraft and magic exactly as they were.

JOHN L. MYRES

THE 'SQUARES' METHOD FOR POTENTIAL PROBLEMS

Relaxation Methods in Theoretical Physics

A Continuation of the Treatise on Relaxation Methods in Engineering Science. By R. V. Southwell. (Oxford Engineering Science Series.) Pp. vii + 248. (Oxford: Clarendon Press; London: Oxford University Press, 1946.) 20s. net.

SOME six years ago Dr. Southwell published his now famous treatise on "Relaxation Methods in Engineering Science", in which he gave an account of the investigations of his school of research workers into the applications of relaxation methods to

systems of finite freedom and to continuous systems in one dimension. In this second treatise he expounds the applications of the relaxation method to numerous problems of continuous systems in two dimensions, with special reference to plane-potential and associated problems. A great variety of physical problems is considered in detail, the examples being selected from the domains of electricity, hydrodynamics, electricity and magnetism, the conduction of heat and hydraulics. In all, some thirty-five problems are discussed with full numerical details, so that this volume forms a remarkable tribute to the energy and enthusiasm of the author and his fellow workers.

This volume, like its predecessor, is deliberately limited to the researches of Dr. Southwell and his team, and does not attempt to discuss the earlier theoretical work of Courant on the extensive practical investigations of Thom. It is complete in itself and provides all that is necessary for the student who wishes to master this increasingly important mathematical technique. The abundant diagrams and numerical tables form most valuable supplements to the exposition in the text. This latter is strictly elementary in character and employs no concepts or methods save those which should already be familiar to the mathematical physicist or engineer.

The growing success and popularity of relaxation methods, which Southwell's work has done so much to promote, have made it no longer necessary to defend the use of these methods, which have in fact become well recognized and established weapons of numerical computation. It may, however, be useful to give a brief account of the essential features of the method as applied to the simplest two-dimensional problem—the numerical evaluation of a potential function which takes assigned values on a given closed boundary.

Such a potential function, say $f(x,y)$, satisfies Laplace's equation, $\partial^2 f/\partial x^2 + \partial^2 f/\partial y^2 = 0$, in a domain A , and takes prescribed values on the curve B which bounds A . It is also well known that the function which is required will minimize the integral $\iint\{(\partial f/\partial x)^2 + (\partial f/\partial y)^2\} dx dy$ taken over A , subject to the boundary condition on B . Now the first step in relaxation theory is to replace the domain A by a lattice of equal squares which covers A , and the rectilinear boundary of which agrees as closely as possible with B . The value of f is then sought at each point of this lattice.

Laplace's differential equation is then replaced by the associated difference equation, $f_A + f_B + f_C + f_D = 4f_P$, where the symbols denote the values of f at the corners of the square $ABCD$ with centre P . The function which satisfies this equation at all the points P of a square lattice covering A and which takes assigned values at the boundary points will minimize the sum

$$D = \Sigma\{(f_A - f_P)^2 + (f_B - f_P)^2 + (f_C - f_P)^2 + (f_D - f_P)^2\}$$

taken over all the points P of the lattice.

The second step in relaxation theory is to determine the best possible way of improving any approximation to f given by numerical values at the lattice points. In practice we can alter the value of f only at one point at a time; and it is easily proved that the best way of altering the value of f at a point P is to replace f_P by $\frac{1}{4}(f_A + f_B + f_C + f_D)$. This change reduces the value of D by the maximum amount.

Relaxation technique then consists in systematically working over the lattice and everywhere replacing

the original approximate values of f by the means of its values at the neighbouring corner points. The successive approximations found in this way converge to the exact solution of the difference equation—and this solution is an approximate solution of the original Laplace's equation.

The theory and practice are equally simple. All that is demanded of the computer is inexhaustible patience and energy. The method is clearly capable of wide extension to many other problems of mathematical physics. In practical computation there are numerous devices for facilitating the application of the general principle, but these artifices are best learnt, pencil in hand, reworking such problems as are described in Southwell's treatise. G. TEMPLE

LIFE AND FOOD OF INSECTS

Insect Dietary

An Account of the Food Habits of Insects. By Prof. Charles T. Brues. Pp. xxvi+466+22 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1946.) 28s. net.

IN these days the amateur in natural history needs to absorb more and more of the products of scientific study if he is to get the fullest enjoyment from his observation of Nature; and the professional biologist has equal need of the knowledge, the enthusiasms and the gift for sympathetic observation of the field naturalist if his biology is to remain the science of living things. Therein lay the virtue of the late W. M. Wheeler's vivid books on insect life, "Social Life Among Insects" and "Demons of the Dust". These are inexhaustible mines of information about the creatures with which they deal; but, throughout, the natural history is informed by a profound knowledge of scientific theory and, for that matter, of the philosophical implications of science.

It is in this light that the book on the diet of insects by Prof. Brues, for many years an intimate colleague of Wheeler at the Bussey Institution at Harvard, is to be viewed. The reader is not to look for a carefully documented and systematic account of the vitamin requirements of insects, of the relative nutritional value of different proteins or amino-acids, of the ability of insects to utilize specific sugars, or of the properties and distribution of their digestive enzymes. Rather, the author displays the whole vast panorama of ravenous jostling insects, carnivorous and vegetarian, saprophytic, predaceous and parasitic; sucking the juices of plants and animals; destroying the crops of man or devouring one another. The importance of detailed scientific analysis is fully recognized, but as a rule the field is lightly sketched in; the reader is then told where to go if he wishes to pursue the subject for himself.

Getting food is such an important part of life that the author is led into many by-ways of the natural history of insects. The diversity of insects, their abundance as species and as populations are reviewed. Their range of habitats comes in for discussion; the lack of marine insects; aquatic life; adaptation to existence in the desert, in caves, in the soil, or as parasites. The colours of insects are found to be a part of the story; so is the determination of castes in social insects—how far is this controlled by food, and how far by genes? Seeking food for its own consumption or providing for its offspring involves the insect in all the complexities of behaviour. So

we have sections dealing with the selection of host plants by the egg-laying female; ancestral memory; conditioning; and biological races associated with particular food plants. There is no special emphasis on economic entomology, but this necessarily comes frequently into the picture; and the use of insects in the control of weeds or of other insects and such-like topics are lightly touched upon.

This catalogue represents only a fraction of the subjects covered; the book indeed amounts almost to a general natural history of the insects. It is written in a discursive style and the author enjoys an occasional joke. The author refers to the aberrant coccinellids of the genus *Epilachna* as vegetarian insects which can proudly trace their distaste for flesh as far back as Mesozoic times; and what are commonly contrasted as determinate evolution and orthogenesis, he depicts as natural selection and natural cussedness. The reader who is fond of insects will find new facts to interest him on every page; and after each chapter there is an elaborate classified bibliography which will be invaluable to the serious student. For those who can remember what a host of topics are embraced by 'insect dietary', this book will prove a most useful source of reference. It has good indexes to authors and subjects, and the text is lightened by a series of well-chosen line drawings and excellent photographs, mostly by the author.

V. B. WIGGLESWORTH

BIOCHEMICAL PERSPECTIVE

A Textbook of Biochemistry

By Prof. Philip H. Mitchell. Pp. xv+640. (New York and London: McGraw-Hill Book Co., Inc., 1946.) 25s.

THIS addition to an already lengthy list of textbooks of biochemistry which have appeared recently, for the most part in the United States, is, we may say at once, very well done. A glance through its pages shows the very extensive changes which have come over the biochemical scene in recent years. The older books began with rather lengthy accounts of the necessary background of organic chemistry, and sometimes physical chemistry; leading to a description of those compounds which are of importance as the products or intermediaries of vital processes. The materials of which living organisms are constructed now occupy the centre of the stage, and this book, which excellently illustrates the trend and direction of the science, spends very little time on the organic and physical background. Indeed, in the preface the author states his belief in no uncertain way: "The central theme and the chief goal of biochemical study is an explanation of the real chemistry of life. While the chemistry of foods and of dead tissues is helpful corollary material, the essentials are the reactions of living protoplasm. Accordingly emphasis in the text has been given and major space allotted to such subjects as the constitution and activity of enzymes, the intermediary reactions of anabolism and catabolism and the vital significance of hormones and vitamins".

After preliminary chapters on carbohydrates (this seems unnecessary if organic chemistry is taken as known), on photosynthesis and on fats, the author plunges at once into the central part of the subject—the proteins and amino-acids, the nucleoproteins and nucleic acids, the vitamins and enzymes. With this basis he can then deal with what he regards as his

most important task—the study of nutrition—though not everyone would agree that “the chief present day mission of biochemistry would seem to be the establishment of nutrition as a science rather than leaving it as one of the arts”. With this in mind he proceeds to the study of the various types of biochemical processes and systems: digestion, blood and lymph, respiration, biological oxidation, carbohydrate and protein metabolism, etc.; and winds up with interesting and up-to-date accounts of the chemistry of hormones and chemotherapy.

The reviewer, a recent recruit to the biochemical field, found the book very informative. To students it will be a mine of information, and it can also be recommended to chemists in general who want a readable and not too lengthy account of what has been going on in biochemistry in recent years. It is up to date, as may be judged from the following matters, which are treated in considerable detail: the penicillins; other antibiotics such as gramicidin, tyrothricin, streptomycin and bacitracin; oestrogenic substances, the pituitary hormones, the gonadotropins, the renin-hypertensin system, folic acid (to a point just preceding the recently announced structural formula of Angier and others). There is a good collection of references for further reading at the end of each chapter, chosen from British and American journals, but excluding other languages.

Many text-books give an unwarranted impression of completeness, and it must be counted a virtue in a text-book if it goes out of its way to emphasize the unknown. A final quotation, taken from an epilogue to the chapter on biological oxidation, will indicate the author's admirable attitude. “In spite of all that is known about bio-oxidation, it is a drama of which the plot is still unsolved. The biochemist is a stage hand. His position in the wings has enabled him to get acquainted with some of the actors (enzymes), to see the properties (foodstuffs) going on the stage . . . to know that the play goes to a successful conclusion. . . . But how the plot works out, he does not know.” The same might well have been written as the epilogue of the whole book.

J. A. V. BUTLER

CLINICAL STUDIES ON MALE FERTILITY

Studien am menschlichen Sperma

Von Charles A. Joel. Pp. 154+10 plates. (Basel: Benno Schwabe und Co., 1942.) 20 Swiss francs.

PART I of this book is a review of seminology from ancient to modern times. It is well documented with references, but is little more than a list of authors and their discoveries arranged in historical order. It fails to arouse interest in a subject which might have been presented as one of the most important in biology and medical science.

The second and principal part of the book deals with the investigation of human semen from the clinical point of view, and is largely based upon the author's examination of more than a thousand semen samples. Methods of collection, preparation and examination for sperm density, motility and morphology are described very fully. This section of the book will be most useful to the clinician.

According to the characteristics of the semen samples the author divides cases of impaired fertility

into five groups. The groups cover a very wide range from complete aspermia to slight oligospermia. These extreme cases are, of course, easily diagnosed from the semen characteristics, but the author does not make clear what degree of reliability can be attached to the results of semen examination, and how accurately they can be used for the diagnosis and prognosis of less extreme cases of impaired fertility. There is no critical analysis of the case histories.

A short section of the book is devoted to chemical experiments with human sperms. The author's own experiments are neither extensive nor very conclusive.

The section on the enzymes of the semen is confusing. This is partly due to the limitations of the material. Human semen samples, especially clinical specimens, are of small volume, contain relatively few sperms and have a high but variable content of the accessory fluids. They are therefore not very suitable material for the study of the metabolic processes of the sperms. On the other hand, the semen of the domestic animals is available in good quantity and makes ideal material for enzymic studies on the respiratory processes. It is unfortunate that the author has not had access to the recent work on sperm metabolism carried out on farm animals in the United States and Great Britain. His own experiments deal primarily with reactions in the seminal fluids and have little bearing upon sperm metabolism.

The section on the biology of the human spermatozoa is confined to a study of survival in the female tract. The author found motile sperms in the vagina up to fifty-five minutes, in the cervix up to forty hours, and in the uterus up to twenty-five hours.

A very short chapter on the role of the marriage partners in sterile marriages completes the book. It is estimated that about 49 per cent of sterile marriages are due to the male. In about 25 per cent sterility could not be attributed to either partner by clinical examination.

ARTHUR WALTON

REVIEWS OF CURRENT PHYSIOLOGY

Annual Review of Physiology

Edited by James Murray Luck and Victor E. Hall. Vol. 8. Pp. viii + 658. (Stanford University P.O., Calif.: Annual Reviews, Inc.; London: H. K. Lewis and Co. Ltd., 1946.) 5 dollars.

IT is the declared editorial policy of the “Annual Review of Physiology” that a review should not only survey the recent contributions to the field but also “appraise them critically and evaluate with discrimination the present status of the subject”. Of the twenty-five reviews which comprise Vol. 8, 1946, many fall short of this ideal. The reviews of energy metabolism, respiration, physiology of the skin, digestive system, liver and bile, blood coagulation, blood cytology, heart, reproduction, are, for the most part, uncritical compilations of published data. The reviewers of applied physiology, aviation medicine and the physiology of heat and cold have been considerably hampered by the continuing ban on the publication of much war-time research; but a considerable amount of new work on the effects of climatic extremes and anoxia is covered. Nerve and

synaptic transmission by G. H. Bishop, the somatic functions of the central nervous system by A. E. Walker and the visceral functions of the nervous system by K. Hare can all be commended as critical and stimulating reviews. Hare's article is particularly valuable in developing the modern view that there is no functional antagonism between the sympathetic and parasympathetic systems. Developmental physiology by L. B. Flexner records further rapid growth in this new field, and it is interesting to note that the *in vitro* fertilization of human ova has been reported.

R. F. Pitts presents an excellent review of the kidney. In renal physiology attention continues to be focused on the use of clearance methods for the measurement of glomerular filtration rate, renal blood flow and tubular activities. The concept of competition for secretory and reabsorptive mechanisms in the renal tubules has proved very fruitful. The use of *p*-aminohippurate, which competes with penicillin for a secretory mechanism and so reduces urinary loss of penicillin during therapy, is an important practical outcome. Perhaps the most striking advances are in the review of the lymphatic system, where O. Cope and L. Rosenfeld deal with the relation of endocrines to the lymphatic system, the remarkable changes which occur in the 'alarm reaction' of Seyle, and the pituitary-adrenal control of the release of protein from the lymphocytes. In metabolic functions of the endocrine glands, E. W. Dempsey confines himself to certain new aspects of endocrinology, notably the relation of hormones to enzymes, hormone inhibitors and hormone antibodies. In physiological psychology, R. H. Seashore prefaces his survey of current literature with a general account of the principles and problems of this subject, for which the ordinary physiologist will be very grateful. In pharmacology, M. L. Tainter, L. C. Miller and T. J. Becker have concentrated on enzymes, dealing with the action of drugs on enzyme systems and the all-important subject of substrate competition. A short review of shock by M. I. Gregerson presents the considerable changes in outlook which have resulted from the Second World War and provides a most intelligible account of this difficult subject. Other subjects reviewed are effects of ultra-violet radiation, physiological aspects of genetics, and audition.

It is interesting to observe that most of the advances in fundamental physiology during the past two years have arisen directly or indirectly from the war-time study of problems in applied physiology.

O. A. TROWELL

CHROMATOGRAPHY FOR BEGINNERS

An Introduction to Chromatography

By Dr. Trevor Iltyd Williams. Pp. xi+100+8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1946.) 10s. net.

A BOOK that states its objective in the preface, and that precisely fulfils it in ninety-six crisply written pages, must be warmly commended. The objective, though limited, is worthy—"to provide a readable and descriptive account of chromatography", primarily for university students. Unlike the two earlier books on the subject, the first by

Zechmeister and Cholnoky (translated by Bacharach and Robinson), the second by Strain, this one makes a deliberate selection of the available material, instead of presenting the lot in bewildering completeness. The result is a reasonably well-balanced account, with the emphasis upon technique and potentialities rather than upon past achievements. The reviewer was pleasantly surprised to find one after another of his pet tricks of technique described, until there was little left to quibble about. The frequent cross-references to other pages will also be very useful to a student using the book as a guide to practical work. Moreover, the author has not been content to select his examples from the older literature; for example, a whole chapter is devoted to the elegant techniques of partition chromatography on damp silica, starch, or strips of filter-paper, developed since 1941 by Martin, Synge, Gordon and Consden.

The chief criticism to be made of the book is that scarcely any indications are given of the capacities of adsorbents until Chapter 8, where most of the examples concern columns very much larger than students would normally employ. It would have been more helpful to include experimental details for a short series of practical exercises. Besides being of direct value to the student, these would have served as useful guides to the research worker needing to attempt similar separations. The point might have been made that only the powerful adsorbents will hold as much as 1 per cent of their own weight of adsorbed material—which is of great advantage in micro-analysis but a nuisance in preparative work. Another practical tip worthy of mention, even in an elementary text-book, is the advantage usually to be gained in sharpness of separation by applying the solute in fairly concentrated rather than dilute solution; also the value of *short* columns of alumina or charcoal—on Buchner funnels even—for removing the most strongly adsorbed component from a mixture, notably tar from organic preparations.

Dr. Williams deplores the term 'chromatography'. However, it is far too late to change it now, and after all it is a nice colourful word, descriptive either directly or indirectly of much of the art. For if the substances to be separated are initially colourless, one does one's best to get colours from them by putting indicators on the column (partition chromatography of acids; quenching of fluorescence by adsorbed substances), by viewing the column in ultra-violet light, or by applying colour reactions to eluates or to the column itself (streak method). In any event, the author's alternative, 'adsorption analysis', at once excludes what promises to become at least as important, namely, partition chromatography. If we really need a new term it should be one that emphasizes the *principle* involved in these separations on columns, namely, the repeated equilibrations of successive elements of one phase with successive elements of another, as in the analogous liquid-vapour fractionating columns. Authors of text-books on chromatography might not then turn a blind eye to another subject that should legitimately be included, namely, the manifold uses of natural and synthetic ion-exchange materials.

To extract materials from a column Williams 'elutes' it, whereas Strain felt obliged to 'elutriate' it. Williams (in conformity with the English translation of Zechmeister) calls the eluting agent the 'eluent'; in this instance, and for no logical reason, I prefer the American variant 'eluant'.

E. LESTER SMITH

Selected Topics from Organic Chemistry

By Dr. D. D. Karve and G. D. Advani. Pp. iv+284. (Poona: Dastane Brothers, 1945.) 8 rupees.

THIS book attempts to cover a wide field of organic chemistry in a small space, and much of the information contained in it is very condensed; the evidence for the structures of terpineol (p. 46) and carotene (p. 116), for example, is given too briefly to be of value. In a discussion of the Beckmann transformation the authors mention that it is used for determining the configurations of oximes and correctly show the trans-interchange, but give no reason for this, nor any comment on the fact.

In certain cases the choice of material is peculiar; a chapter on "Some Important Condensation Reactions" starts with the Pechmann condensation and continues with the Fries reaction. Dealing with the structure of benzene it is stated that the hydrocarbon can be reduced successively to C_6H_8 , C_6H_{10} and C_6H_{12} , and Kekulé's formula is 'proved' without any mention of resonance; nor, for that matter, is resonance mentioned in discussions of colour and constitution, tautomerism or free radicals.

Many misstatements of fact appear: it is stated that citral gives acetone, carbon dioxide, water and levulinic acid on oxidation, and no mention is made of any oxalic acid. The following are quotations: "A compound, even though it may contain asymmetric groupings, is optically inactive if it has a plane or an axis of symmetry" (p. 7). "Due to the introduction of a new asymmetric carbon atom it is possible to account for a reactive hydrogen atom . . . [in glucose]" (p. 10).

"Claisen's condensation. Two molecules of an ester or an ester and a compound having a CH_2 group in proximity to a CO or CN group condense to form β -keto esters or β -ketones" (p. 237).

"In many cases, the crystallization of a racemic compound can be brought about in such a way that the two active modifications form separate crystals" (p. 244).

"The solution of sodium nitrite is then made up to exactly N/2 by adding the calculated amount of water or sodium nitrite" (p. 267).

Statements such as these rather tend to shake one's confidence in the accuracy of the information in general.

F. B. KIPPING

An Introduction to Electronics

By Prof. Ralph G. Hudson. Pp. x+97+37 plates. (New York: The Macmillan Company, 1946.) 15s. net.

THE spectacular results of the release of nuclear energy from the atom have certainly caused the general public, not merely the scientific workers, to ponder deeply, and, if for this reason alone, this book will be welcomed. It deals only with one phase of atomic structure, namely, the electron and its applications, though there is one useful chapter on the constitution of matter generally.

The author suggests that the science might have been called 'protonics' or 'neutronics' instead of 'electronics', but in the reviewer's opinion the correct title has been used. So much is known about the electron that it can almost be regarded as an old friend; but there is much yet to learn about the proton and the neutron, especially how these constituents of the atom will interact under all conditions.

The subject is developed in a very logical way, and the matter is expressed in terms easily under-

standable by the reader who is prepared to go slowly and concentrate. It is up to date and gives a clear knowledge of the properties and control of the electron, which is regarded as the most active ingredient of matter, and it describes and illustrates many electronic devices used in industry and elsewhere. It is well written and splendidly illustrated with a profusion of most interesting plates.

The author concludes, "Electrons are the happy and faithful slaves of every man". The general public will perhaps be relieved when this remark can apply to the whole realm of atomic energy.

Nucleonics

What Everybody should know about Atomic Physics, Pp. ii+38. (Washington, D.C.: Progress Press, 1946.) 1 dollar.

THIS little book, of anonymous authorship, deserves a better title. It goes well beyond what is likely to appeal to the non-scientific reader who is interested by the practical applications of nuclear physics, and though it is clearly not intended for the serious student, he will find it interesting and sometimes illuminating.

It consists mainly of a clearly written and well-illustrated account of some of the phenomena and instruments of nuclear physics, leading to a description of the principles of fission piles and 'atomic' bombs; a large amount of information is contained in small compass, and though the order of presentation is unconventional, the main principles are well expounded. There are misconceptions and slips that would not pass a physicist's scrutiny, and the references to people and dates are often misleading, quite apart from an understandable concentration on American developments. A piece of fiction concerning Prof. Bohr on p. 29 is better not quoted!

Considered, however, as a frankly popular work, it is of refreshingly high standard compared with the mushroom growth of cheap books that, particularly in the United States, have sought to exploit public interest in atomic energy.

A Naturalist on Lindisfarne

By Richard Perry. Pp. 248+16 plates. (London: Lindsay Drummond, Ltd., 1946.) 15s.

OFF the Northumberland portion of the coast of England lies the island of Lindisfarne, also the smaller islands known as the Inner and Outer Farnes, all the haunt of sea-birds, much frequented by winter visitors and a halting-place for passing migrants. So St. Cuthbert found when he was appointed prior in 673, his special care being the eider ducks, which to this day are known as St. Cuthbert's ducks. Mr. Perry, wending his way some 1200 or more years later over the sands that separate Lindisfarne from the mainland, to take up his residence on the Holy Island, found himself in what was little short of an ornithological paradise. In this book he tells us of the island and its life, of the changing seasons, of the comings and goings of the bird population, with many observations on details of behaviour, including a chapter on the fulmar petrel with special reference to the homing of this species, which he records as visiting its nesting ledges in December. His appendix of the chronological history of the colonization of Holy Island by the fulmar embodies useful data, and another appendix is a painstaking list of the birds of Holy Island.

FRANCES PITT

SIR THOMAS MORE AS PUBLIC HEALTH REFORMER*

By SIR ARTHUR S. MacNALTY, K.C.B.

SIR THOMAS MORE was a great forerunner of Edwin Chadwick in public health reform. More is renowned as saint and martyr; he was an eloquent orator, an eminent statesman and legislator, Speaker of the House of Commons, royal ambassador and Lord Chancellor, a master of English prose, and a classical scholar. These great gifts united in one man, in the very blaze of their glory have obscured Sir Thomas's teaching and work in public health and social medicine.

Thomas More (1478-1535), son of Sir John More and Agnes Grainger, was educated at St. Anthony's School in Threadneedle Street, and brought up in the household of Thomas Morton, Archbishop of Canterbury and Lord Chancellor. During 1492-94 he was an undergraduate at Canterbury Hall, Oxford, where he came under the influence of the Humanists, Linacre and Grocyn. In 1496 he became a member of Lincoln's Inn and was called to the outer Bar in 1501. Dean Colet was his spiritual director. He met Erasmus in 1499—the beginning of a life-long friendship.

In 1501, at Grocyn's invitation, More lectured in the Church of St. Lawrence Jewry on St. Augustine's "de Civitate Dei". The lectures were historical and philosophical, and possibly criticized the social evils of the time. The chief and best-learned men of the City of London came to hear him.

The Influence of Linacre

We know that Thomas More read Aristotle, for he speaks of attending Linacre's course on the *Meteorologica*¹. This study Linacre must not only have trained Thomas in politics, ethics and political economy, but also probably interested him in biology and natural history. In Holbein's portrait of More and his family, the artist has sketched in a small monkey beginning to climb up Lady More's dress. Further evidence of More's love of animals is obtained from Erasmus, who wrote of him²:

"One of his great delights is to consider the forms, the habits, and the instincts of different kinds of animals. There is hardly a species of bird that he does not keep in his house, and rare animals, such as monkeys, foxes, ferrets, weasels and the like."

The interest in natural history, as often happens, was associated with an interest in medicine and public health, and it is scarcely an assumption to say that More derived this from his Greek tutor, Thomas Linacre (1460-1524), who was equally renowned as physician and classical scholar. Linacre is, of course, famous for the large share he took in elevating the standard of medical education and in the foundation of the Royal College of Physicians in 1518, of which he was the first president. He founded medical lectureships bearing his name at Oxford and Cambridge, for which it is interesting to note that Sir Thomas More, Tunstall, Bishop of London, and two other persons were appointed trustees.

Linacre wrote several grammatical works and translated Galen into Latin. Erasmus mentions other

completed works laid up in Linacre's desk, unpublished. It is not improbable that one or more of these lost works dealt with public health, for both Linacre's pupils, Sir Thomas More and Sir Thomas Elyot, were interested in the preventive aspect of disease and the preservation of health. We can reasonably surmise that More learned much from Linacre, and that this teaching led him to become a pioneer in public health administration.

More's Interest in Medicine

In the sixteenth century, the study of Greek not infrequently led on to that of medicine, and Thomas More encouraged this departure in his own household. The house at Chelsea was always full of scholars and pupils. Nicholas Kratzer, Henry VIII's astronomer, was a frequent visitor, as were Erasmus and other scholars from overseas. More believed in the higher education of women, and his daughters were liberally educated. Erasmus wrote to Ulrich von Hutten in the letter to which previous reference has been made:

"I should rather call his house a school, or universitie of Christian religion, for there is none therein but readeth or studieth the liberrall sciences; their speciall care is pietie and vertue, there is no quarelling or intemperate words heard, none seen idle, which household that worthy gentleman doth not govern by proude and loftie words, but with all kind and courteous benevolence: everybody performeth his dutie; yet is there always alacratie; neither is sober mirth anie thing wanting."

There are at least three instances of members of More's learned household studying medicine. The first is Margaret Gigs, the foster-sister of More's daughter Margaret, who was to him "as dear as though she were a daughter". She was a Greek scholar, fond of mathematics and studied medicine. More relates, in the "Second Booke of Comforte Agaynste Tribulacyon", that when he lay in a tertian fever, symptoms arose which baffled his two physicians, but Margaret Gigs, then a young girl, identified the condition in Galen's "de differentiis februm". More made Margaret Gigs his almoner for his outdoor charities, and she married Dr. John Clement, More's pupil, whom she had known from a child, and helped him in his medical work and classical studies. Clement became Wolsey's lecturer in rhetoric at Oxford, then professor of Greek, and was president of the College of Physicians in 1544³.

More's third medical protégé was Richard Hyrde. He was tutor to More's children, and when Margaret Roper translated Erasmus's "Treatise on the Pater Noster", Hyrde contributed an introduction in English which justified the right of women to a scholarly education. Hyrde's study of Greek authors attracted him to medicine. As physician he accompanied Bishop Gardiner on his embassy to the Pope in 1528, and died of a chill.

More's writings contain many illustrations and comparisons drawn from his medical knowledge. This is strikingly exemplified in his unfinished treatise, "De Quatuor Novissimis", "The Four Last Things", written in 1522, when he had just been knighted and was under-treasurer. It is a meditation on death, and he describes the book as "a short medicine, containing only four herbs, common and well known, that is to wit, death, doom, pain and joy".

"For what would a man give for a sure medicine that it should all his life keep him from sickness,

* Abstract of a Chadwick Public Lecture given at the Royal Society of Tropical Medicine and Hygiene on October 8, 1946.

namely, if he might by the avoiding of sickness be sure to continue his life one hundred years."

In Sir Thomas's last book, "A Dyalogue of Comforte Agaynste Tribulacyon", written in 1534 when he was imprisoned in the Tower of London, there are again many instances culled from the author's medical lore.

In his keen observation, in his reflexion and deductions, and in his dislike of over-drugging, More had all the endowments of a wise physician. It is apparent that he would have been a great one if he had chosen medicine as his profession. Evidently he was intensely interested in medical studies and in the art of healing.

Commissioner of Sewers

In 1510, More was appointed one of the Under-Sheriffs of the City of London, which gave him opportunity to advise the Corporation on sanitary reform. This interest in public health was further shown by his appointment in 1514 as one of the commissioners of sewers along Thames Bank between East Greenwich and Lambeth.

The improvement of London's water-supply was much in More's mind when he described the river of Anyder, on which Amaurote, the chief city of Utopia, was situated, for Anyder, like the Thames, is a tidal river.

Throughout his career More, despite the claims of high office, continued with his work for the improvement of England's water-supplies. In 1526 he was again appointed commissioner of sewers for the coast of the Thames, from East Greenwich to Gravesend, and, as Lord Chancellor, he probably initiated the important Act of Parliament (23rd Hen. VIII, C.5), which appointed commissioners of sewers in all parts of the kingdom.

"Utopia"

"Utopia" was partly written at Antwerp, when More was ambassador to the Archduke Charles, afterwards Charles V, in 1515, and was completed in England. "Utopia" is 'No-Where', the imaginary Commonwealth of the Renaissance idealists. It advocates many social reforms; in addition, it devises a most complete system of health reform which was greatly in advance of his time, and in some respects in advance of our own time.

More envisaged a well-built city with gardens and open spaces, a public water-supply, drainage and cleaned streets, with public abattoirs outside. Public hospitals were provided for the treatment of rich and poor, and isolation hospitals for cases of infectious disease. Other amenities included communal meals, the safeguarding of maternity with municipal nurses for infant welfare, nursery schools (or crèches) for children under five, free universal education for all children, with continuation, adolescent, and adult schools; religious instruction, industrial welfare, enlightened marriage laws and eugenic mating, and obedience to the laws of health, including fresh air and sunlight, and active occupation without undue fatigue. It is a comprehensive programme of social medicine which, written in the sixteenth century, expresses many of the aspirations of to-day.

Interest in Care for the Sick and Infirm

More's interest in medicine and the prevention of disease were joined with a kind and charitable heart,

which was touched by all forms of human suffering. This is revealed in the words of Thomas Stapleton, whose "Life of More" appeared in 1588.

"More was used, whenever in his house or in the village he lived in there was a woman in labour, to begin praying, and so continue until news was brought him that the delivery had come happily to pass.

"The charity of More was without bounds, as is proved by the frequent and abundant alms he poured without distinction among all unfortunate persons. He used himself to go through the back lanes and inquire into the state of poor families; and he would relieve their distress, not by scattering a few small coins, as is the general custom, but when he ascertained a real need, by two, three or four gold pieces.

"When his official position and duties prevented this personal attention, he would send some of his family to dispense his alms, especially to the sick and the aged." This office, as already mentioned, was frequently performed by Margaret Gigs. "He very often invited to his table his poorer neighbours, receiving them . . . familiarly and joyously; he rarely invited the rich, and scarcely ever the nobility." Not a week passed without his taking some poor sufferer into his house and having him tended. In his parish of Chelsea he hired a house, to which he gathered many infirm, poor and old people, and maintained them at his own expense. When More was away, his eldest daughter, Margaret . . . had the care of this house.

"He even received into his household and supported a poor widow named Paula, who had spent all her money on a lawsuit."

The relief of the destitute and care of the sick were largely in the hands of the religious houses, and it was not until after the dissolution of the monasteries that the poor became a State problem, necessitating Poor Law legislation. More, in his wisdom and humanity, would have devised a sound system of Poor Law relief. The Poor Law legislation of Henry VIII and Edward VI put the onus of relief on the charity of local districts, and the problems of unemployment and destitution were not handled effectively until the celebrated Poor Law Act of Elizabeth in 1601.

More as a Health Administrator

There was much epidemic disease in Tudor times. Outbreaks of typhus fever appeared in Europe and began to be frequent in the towns and overcrowded gaols of Britain. Typhoid, dysentery and malaria were endemic. Sir Thomas himself suffered from a tertian fever. Creighton notes an epidemic of influenza in 1510. The deadliest epidemics were plague and the 'sweating sickness'. During 1511-21 there is not a single year without some reference in the letters of Erasmus and elsewhere to the prevalence of plague.

The sweating sickness was one of those mysterious maladies, like influenza and encephalitis lethargica in our own time, which suddenly appear, wreak havoc and destruction for a time, and then as suddenly disappear. The disease was first noted in August 1485, and was also brought to England in the army of Henry VII, which landed at Milford Haven⁴. It spread to London, where it caused great mortality. Sweating sickness has been identified by Dr. Creighton, the epidemiologist, and Dr. Michael Foster with 'miliary fever' (*schweissfriesel*, *suetie militiaire*, or 'the Picardy Sweat'), a malady repeatedly observed

in France, Italy and south Germany, but not in Great Britain. It was characterized by intense sweating and an eruption of vesicles, lasted longer than sweating sickness, occurred in limited epidemics, and was usually not fatal. The first epidemic was seen in 1717 and it continued to 1906, and even later. Dr. Michael Foster and Sir Henry Tidy saw cases of the disease in France during the First World War⁵.

In the summer of 1517, London was visited by a virulent outbreak of the disease, which spread by the following year all over the country, and especially in the crowded towns. Colet succumbed to the infection, Wolsey had more than one attack, and Andreas Ammonius, Henry VIII's Latin secretary, died of it.

More noted the danger of relapse in sweating sickness. "Considering there is, as physicians say, and as we also find, double the peril in the relapse that was in the first sickness."⁶

Plague was also prevalent, and the diseases terrified King Henry, who fled from London to Windsor, and thence to Abingdon. In April 1518, both plague and sweating sickness were rife in Oxford. The King appointed More, who had returned from the embassy to Calais, to supervise the health measures to be taken in this emergency. On April 28, Master More certified from Oxford to the King at Woodstock that three children were dead of the sickness, but none others; he had accordingly charged the Mayor and commissary in the King's name "that the inhabitants of those houses that be and shall be infected, shall keep in, put out wispes [of hay] and bear white rods, according as your Grace devised for Londoners". They were also forbidden to keep animals in their houses, and officers were required to keep the streets of the town cleansed and to burn refuse.

Here we see notification and segregation used for the prevention of epidemic disease, and Thomas More controlled it by these means. The King's Council approved these measures, and in June 1518, Pace wrote from the Court at Woodstock to Wolsey that "all are free from sickness here, but many die of it within four or five miles, as Mr. Controller is informed".

On July 18, More wrote:

"We have daily advertisements here, other of some sweating or the great sickness from places very near unto us; and as for surfeits and drunkenness we have enough at home."

In the severe outbreak of 1528, More's daughter, Margaret, nearly succumbed to the sweating sickness. Anne Boleyn was attacked by it, and her royal lover hastily left her for several weeks.

More's excellent sanitary regulations, no doubt, helped to prevent more widespread infection and to diminish the virulence of these pestilences. The first plague order was issued in the thirty-fifth year of Henry VIII, in 1543, and, as Creighton remarked, contains the germs of all subsequent preventive practice. More had then been dead for eight years, but the order codified his previous regulations and instructions. Instead of wisps of hay, the sign of the cross is to be set on every house which might be afflicted with the plague, and there continue for forty days. Segregation, disinfection—chiefly by burning straw pallets, etc., and scouring—and the bearing of white rods by plague contacts are enforced, and this additional humane regulation breathes the spirit of Thomas More: "That no housekeeper should put any person diseased out of his house unless they provided housing for them in some other house."

The more one delves into State papers of the time of Henry VIII, the more one reads Sir Thomas More's books, treatises and letters, and studies the account of his work in the letters of Erasmus and other contemporaries, the more one marvels at his wisdom and his outlook upon hygiene and public health.

Hospital Reform

This admiration for More is further enhanced when we examine his views on hospitals. He was a protagonist of hospital reform. In "Utopia" he sets forth a hospital scheme in these words:

"For in the circuite of the citie, a little without the walls, they have iiii hospitalles, so bigge, so wyde, so ample and so large, that they may seme iiii little townes, which were devised of that bignes partly to thintent the sycke, be they never so many in nombre, should not lye to thronge or strayte, and therefore uneasely and incommodiously: and partly that they which were taken and holden with contagious diseases, suche as be wonte by infection to crepe from one to another, myght be layde apart farre from the company of the residue. These hospitalles be so wel appointed, and with al thinges necessary to health so furnished, and more over so diligent attendaunce through the continual presence of cunning phisitians is geven, that though no man be sent thether against his will, yet notwithstandinge there is no sicke persone in al the citie, that had not rather lye there then at home in his owne house."

Sir Thomas More, when he wrote on theological or religious subjects, was often prolix, but in this account of the best form of hospital, its amenities and advantages, he is wonderfully concise. Yet all the points are there: situation, provision for all sick persons, proper furnishing and equipment, medical specialists in regular attendance, everything indeed that we are now endeavouring to obtain for the sick in the middle of the twentieth century.

In his "Supplication of Souls in Purgatory" (1529), written as a counter-blast to Simon Fish's "Supplication of the Beggars", More demonstrated the folly of abolishing the hospitals. He alludes to the benefits they conferred in diminishing the amount of sickness among the destitute, appreciates the value of case-records and statistics, which were lacking in the case under consideration; but, nevertheless, considers that the number of the sick through hospitals are less than in times past, and cites the French pox:

"And then of the french pockes thirty year ago went there about sick five against one that beggeth with them now. . . . As for other sickness the incidence is not greater than in times past."

In his cupidity and lack of humanity for his necessitous subjects, Henry VIII ignored More's wise counsel. The hospitals were suppressed, and the "Five Royal Hospitals" of London, including St. Bartholomew's and St. Thomas's Hospitals, were only preserved through the public-spirited action of the Corporation of London.

Conclusion

More succeeded Wolsey as Lord Chancellor, but he resigned in 1532, as he disagreed with the King's ecclesiastical policy. In 1534 he was imprisoned in the Tower, indicted for high treason in 1535, found guilty on perjured evidence, and executed on Tower Hill, "the blackest crime ever perpetrated in England under the form of law".

Sir Thomas More, as we have seen from "Utopia", devised a most complete system of health and social

reform which was greatly in advance of his time, and in some respects in advance of our own time. His fame as public health reformer, therefore, rests more on planning and prophecy than on achievement. He was, however, a great administrator, and reference has been made to his practical measures as commissioner of sewers in regard to water-supplies and to his distinction in initiating the control of epidemic disease and plague. Had England then been ruled by an enlightened monarch, interested in the welfare of his subjects, public health reform would have been inaugurated on wise lines in the sixteenth century, for Sir Thomas had the root of the matter in him.

¹ Ad Dorpium, "Lucubrations" (1563), 417.

² Letter to Ulrich von Hutten, July 23, 1519.

³ Munk, W., "The Roll of the Royal College of Physicians of London" (1878) vol. 1, 25. Wenkebach, E., "John Clement ein englischer Humanist und Arzt des sechzehnten Jahrhunderts. Sudhoff's "Studien zur Geschichte der Medizin", Heft 14 (Leipzig, 1925).

⁴ See Forrestier, T., British Museum, Addit. MS., No. 27,582, and Creighton's "History of Epidemics in Britain", vol. 1, 237.

⁵ *Brit. Med. J.*, ii, 63, 196 (1945).

⁶ "The Pitiful Life of King Edward the Fifth." Camelot edition, p. 230.

MOSAIC DISEASE OF THE NARCISSUS

By DR. JOHN CALDWELL
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THE problem of 'mosaic' or 'stripe' disease of *Narcissus* has interested growers and others for some considerable time. Recently much work has been carried out on the disease in the United States by Haasis, in Holland by van Slogteren and his colleagues, and in Great Britain by Caldwell and his colleagues. Though not all the details have been worked out, some clear-cut conclusions have been arrived at, and it seems worth while taking stock of the present position.

In the first place, it is now quite clear that the group of diseases commonly called 'stripe' or 'mosaic' in *Narcissus* is caused by a pathogen of the virus group. In the laboratory the disease is readily transmitted by grafting a part of a diseased bulb on to a part of a healthy one, when the healthy bulb is then infected. It is also readily transmitted by rubbing the leaves of a healthy plant with juice extracted from a diseased plant. Infection is increased by the use of carborundum powder with the inoculum. The powder has the effect of rupturing the cells of the leaves without doing extensive damage to the tissues. Virus agents in general cannot enter an unbroken cell, nor, on the other hand, can they develop in a cell which is very badly damaged. One of the difficulties which has been encountered by all workers on *Narcissus* mosaic is that the disease symptoms are not shown by a treated plant in the same season as the inoculation is made. In other words, one has to wait for nearly a year before one can tell whether infection has taken place, so far, at least, as appearances are concerned. A laboratory method which does shorten the time required to ascertain if infection has taken place is by precipitin tests.

In the field the disease is clearly transmitted by the transfer of the virus agent in infective juice by the agency of sucking insects. A great deal of work on this aspect of the subject has been carried out

because, obviously, in commercial holdings infection must take place by natural means. It is considered improbable that much, if any, transmission of the disease agent takes place by the normal methods of cultivation or of cutting flowers and so forth. Haasis, in a short note, has reported that four insects are disease vectors in the United States, and van Slogteren has listed three for Holland, namely, *Aulacorthum solani* (*Myzus pseudosolani*), *Doralis* (*Aphis rumicis*) and *Macrosiphum euphorbiae* (Thomas). *Myzus persicae* (the peach aphid), a common vector of many virus agents, he found not to be a vector for the virus of *Narcissus* mosaic. We in this Department have been unable, so far, to induce any insect under experimental conditions to transmit the disease, and, in point of fact, few insects seem to be common on the *Narcissus*. Curiously enough, no direct evidence has yet been produced by any worker that the mite *Tarsonemus approximatus narcissi* (Banks), which is so common on the *Narcissus*, is a vector of the agent. We are satisfied, however, that some insect is, in fact, the vector under field conditions. We grew blocks of *Narcissus* made up of groups of healthy and of diseased plants of the variety 'Sir Watkin', which, incidentally, has been selected quite independently by all workers as their experimental material. Some of the blocks were separated one from another by wooden frames sunk some feet into the ground to prevent any contact between the roots. In others the roots could freely grow together, but the plants were sprayed from time to time during the growing season with a nicotine spray to kill any insects on the foliage and to discourage insect visitants. Plants in the square of healthy plants, which were isolated from the diseased plants by the wooden frame, were found ultimately to be infected to the extent of thirteen out of sixty-eight, while only two of the sixty-four bulbs in the sprayed block were infected after the same period. This was taken to indicate that spread takes place by the agency of some vector on the foliage and not through the roots, as was suggested by McWhorter some years ago. This conclusion, that is, of aerial rather than root infection, is supported by the work of Haasis and of van Slogteren.

Another difficulty in experimenting with *Narcissus* mosaic is that under certain conditions, notably in the higher temperatures of the early summer or such as obtain in glasshouses, there tends to be 'masking' of the symptoms. This means that plants, the foliage of which show marked symptoms of disease in the colder weather of early spring, may appear almost healthy in the warmer days of early summer. We have a variety of *Narcissus* which develops a most markedly chlorotic leaf when infected. We have found that it is possible, by keeping the plants in pots and exposing them alternately to high and to low temperatures, to induce the leaves to develop alternate green and yellow bands running horizontally across them—a 'zebra' effect.

The existence of 'masking' by temperature and possibly by other environmental conditions necessitates the greatest care in the selection of bulbs to ensure that only really healthy bulbs are used for experimental material. We rogue our healthy 'Sir Watkin' stock rigorously and have watched them for some years before using them as experimental material.

The disease is not seed-transmitted. We have grown many thousands of seedlings from seeds which were obtained from virus-infected plants—pollen

parent diseased, seed parent diseased, and both parents diseased—and in not a single instance have we found the seedlings diseased; nor have the plants afterwards shown symptoms of disease when grown in isolation. This ensures, at least, that breeders and raisers can always begin with healthy stock—unlike, of course, those who propagate varieties by bulbs—and it would obviously pay all raisers of new varieties to take the greatest possible care to ensure that their seedling plants are grown as far away as possible from infected plants.

It is clear that some varieties of *Narcissus* are less affected by the disease than others, and that some varieties continue to flower and to flourish, if perhaps not so well as they might, at least sufficiently well to satisfy the not too-exacting grower. Other varieties, on the other hand, are so crippled by the disease that the plants become progressively smaller and smaller, cease to flower, and may actually 'starve' themselves out of existence. In many of the yellow varieties the flowers are flecked with white or lighter yellow areas, and may even be distorted. Distortion also of the flower-stalk spoils the flower from the gardener's or the commercial grower's point of view. It is now almost certain that there is only one virus agent which causes all these apparently different types of disease, and the difference in symptom-expression is a varietal difference, not a difference in the agent. We have found, for example, that juice from a diseased 'Sir Watkin' plant inoculated into a 'Croesus' plant causes the typical symptoms found in 'Croesus'. Inoculum from 'Croesus' into a healthy 'Helios' plant induces 'Helios' symptoms, and a back-inoculation from the diseased 'Helios' plant induces typical 'Sir Watkin' symptoms in a 'Sir Watkin' plant, and so on. It is clearly essential, therefore, that any suspected plants of all varieties should be 'rogued' as soon as they are noticed, since they will act as sources of infection for other varieties which may be much more susceptible to the disease than are the original diseased plants. This question of susceptibility to disease is one in which much help might be obtained from the grower and especially from the raiser of *Narcissus*. It is quite clear to us, as it must be to anyone who has had occasion to make similar observations, that some varieties are quickly reduced to uselessness by mosaic disease while others are only slightly affected, others again occupying an intermediate position. Clearly this susceptibility must be connected with the hereditary make-up of the variety, and any observations on these points would be most helpful. For example, *Narcissus jonquilla* and its hybrids, in our experience, are apparently little affected by the disease and show very slight symptoms, as also do the *N. poeticus* varieties. *N. triandrus* hybrids, or at least some of them, seem to be very susceptible, and so forth. Incidentally, I have not so far found a single case of mosaic in a plant of the wild *Narcissus pseudonarcissus*, though I have carefully examined many thousands of plants.

As more information becomes available about the nature of the disease, further methods of control may suggest themselves. In the present stage of knowledge, the most effective method is obviously careful roguing of the stocks. Periodic inspections should be carried out and suspected plants should be removed and burnt. Clearly, inspection should begin early in the growing season before there is a likelihood of 'masking' of symptoms by higher temperatures. In small plantings, additional protection could

be afforded by spraying with an insecticide like nicotine. Haasis has suggested that some measure of control might result from the selection of the larger bulbs from a group grown under similar conditions, as the effect of the disease is to reduce the bulb size appreciably. That reduction of size is found in diseased bulbs we have also found, but obviously this method would be only partially effective. Raisers of new varieties should remember that the seedling plants are always healthy, as the disease is not seed-borne, and great care should be exercised in growing new stocks as far away as possible from stocks of diseased bulbs if the latter must not be destroyed.

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SOCIAL MEDICINE AT OXFORD

IN a letter to Fulgenzio, Francis Bacon remarked that "the instauration of the sciences require some ages for the ripening of them". Social medicine may, in some respects, be regarded as an 'instaured', or "renewed" science, for it is one of broad outlook and revives the philosophical attitude with which the Greeks approached the study of social problems and natural phenomena. It is one of the most comprehensive of sciences, calling to its aid many branches of knowledge in the elucidation of its problems. It is fitting, therefore, that the first chair and Institute of Social Medicine have been established at Oxford, a University rich in many founts of learning, including the activities of Nuffield College, which is conducting important investigations into social problems. The University was exceptionally fortunate in securing for its first professor of social medicine so eminent a physician as Prof. John A. Ryle.

The Institute came into being as from April 1, 1943, but, owing to war-time difficulties, its working life only began in the spring of 1944. Yet, as its first annual report shows, a comprehensive programme of work has been drawn up and a number of investigations are already in progress. Certain of these, as the list of publications indicates, have either been completed or have reached a stage which justifies a preliminary report.

The purposes of the Institute are as follows:

(a) To investigate the influence of social, genetic, environmental, and domestic factors on the incidence of human disease and disability.

(b) To seek and promote measures, other than those usually employed in the practice of remedial medicine, for the protection of the individual and of the community against such forces as interfere with the full development and maintenance of man's mental and physical capacity.

(c) If required by the University to do so, to make provision in the Institute for the instruction in social medicine of students and practitioners of medicine approved by the Board of the Faculty of Medicine in the University of Oxford.

A review of the activities of the Institute reveals that the investigations made conform closely with the above requirements. Several of these relate to the health of infants and children. One of the criticisms of the School Medical Service has been the number

and variety of defects among school children. It has been pointed out in successive annual reports of the Chief Medical Officer of the Ministry of Education that these defects come to light chiefly when children are first examined medically on entrance to school. They develop during the pre-school age, and accurate knowledge concerning them is lacking. In 1944 the Institute launched a long-time survey to study and compare the health, development and sickness experience of children in all social groups from the first weeks of life to the age of five. The medical officer of health for Oxford City, his colleagues and the health visitors co-operate in this investigation, which should yield important results. A statistical analysis is being made of the still-birth rates and neo-natal rates in England and Wales in relation to environmental and social factors, and a special genetic study of twins is in progress.

The relationships between occupation and morbidity is another field in which extensive knowledge is lacking. Dr. W. T. Russell is making a statistical analysis of sickness absence at Morris Motors works, Cowley, including correlations of the main causes of sickness with such factors as age, sex, trade and season. On the basis of the initial study, it is hoped later to select particular causes of sickness, such as peptic ulcer and the chronic rheumatic diseases, for a more detailed inquiry into incidence and etiology. It is believed that certain useful analyses will emerge which should prove of ultimate advantage to the health of the workers, to the management and to production. When this inquiry extends to other industrial centres, comparisons of morbidity experience as between different industries, or between factories of the same industry in differently situated districts, should in time become possible.

On behalf of the Goitre Sub-Committee of the Medical Research Council, an extensive survey has been made on school-children at ages eleven to fifteen in several districts of England and Scotland to determine the varying incidence of thyroid hyperplasia in relation to the iodine content of drinking water. Significant variations in incidence have been demonstrated which correspond with variations in the amount of iodine present in the drinking water as well as with the varying incidence of childhood hyperplasia and adult goitre in the country. In the course of the survey a standard method of examining and recording the state of the thyroid gland was established.

Radiographic studies bulk largely in the report. They have been used in the investigations mentioned, and special inquiries are also being made to obtain more precise information on bony changes related to nutrition and intercurrent disease during the period of growth.

These important researches by no means exhaust the activities of the Institute. Its work is intimately connected with the Bureau of Health and Sickness Records in Hospitals (Nuffield Provincial Hospitals Trust). It has helped in investigations directed by the Ministry of Health and other official bodies, and has established itself as a consultative and advisory centre. It is responsible for the teaching of Oxford medical students in social and preventive medicine, and is extending its work in many directions.

Social medicine is an uncharted sea. The information in the present report reveals not only the possibilities of new discoveries, but also how well the work to this end is being directed, planned and organised.

ANATOMY OF THE PRIMARY VASCULAR SYSTEM IN DICOTYLEDONOUS PLANTS

By K. J. DORMER

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A STRIKING feature of botany as the science exists at present is the lack of any coherent body of comparative morphological doctrine dealing with the angiosperms. There are no books on the flowering plants in any way comparable with Bower's work on the ferns or Chamberlain's on gymnosperms. As a result, the treatment of angiosperms in university courses on botany is usually confined to separate and unrelated series of lectures on systematics and on plant anatomy. In seeking a remedy for this remarkable situation one cannot but be impressed by the almost complete neglect of the gross anatomy of the primary vascular system, or what the older anatomists called "the course of the vascular bundles in the stem". Analogy with the study of other groups suggests that this department of anatomy may be expected to yield data of phylogenetic significance. The pioneer paper published by Nägeli¹ in 1858 is still our principal source of information on this topic, the few memoirs which have appeared since that date being for the most part descriptions of the development of single species or accounts of the more obviously aberrant groups such as Piperaceæ. There have also been some publications dealing with the number of traces to a leaf in various families (for example, Sinnott²). The neglect of the subject may be attributed almost entirely to the fact that Nägeli and nearly all subsequent writers have paid altogether too much attention to the supposed basipetal development of the leaf traces, and have described vascular systems in terms of traces running down the stem and joining on to the traces of older leaves. Descriptions framed in this way make very tedious reading, and are so ill-adapted to the comparison of related vascular systems as to be almost unintelligible without the aid of diagrams. Furthermore, such accounts tend to emphasize relatively trivial features, especially the numbers of internodes which the various bundles traverse, at the expense of others which are really far more important.

In some recent publications^{3,4} I have therefore made a complete break with tradition and employed a terminology which is independent of ontogenetic considerations. A primary distinction has been established between 'open' vascular systems, in which the bundles, as they run upward through the stem, branch but do not anastomose, so that the foliar gaps are open for an indefinite distance upwards, and 'closed' systems, in which the foliar gaps are regularly closed by anastomoses of the bundles. An open system is shown in Fig. 1, where the stele is represented as having been cut open down one side and then laid out flat. Crosses denote the median traces of leaves and the small circles lateral traces. Examination of this diagram will reveal a property common to all open systems, namely, the segregation of the primary vascular tissue into a number of units (in this case five), which have no communication with each other except at the base of the shoot, and, in some cases, including the one illustrated, also through the leaves. In closed systems, on the other hand, as in that shown in Fig. 2, the primary vascular tissue

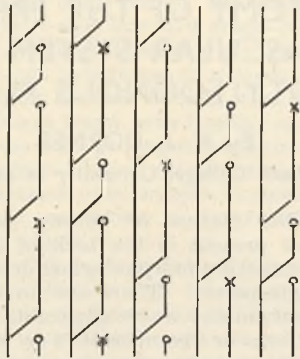
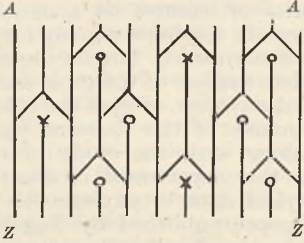


Fig. 1. ACACIAN VASCULAR SYSTEM

Fig. 2. VASCULAR SYSTEM OF *Medicago* sp.

forms a continuous network. (In this figure the bundle lettered *AZ* has been represented twice over.)

In view of the known physiological importance of xylem and phloem, it seems reasonable to suppose that the tangential discontinuity of these tissues in open systems would involve a certain degree of inefficiency. It is therefore of great interest that in all open systems so far investigated interfascicular xylem and phloem are present almost from the beginning. So far as it is possible to generalize from the very scanty data so far available, it appears that the condition so popular with writers of elementary text-books, where fully developed vascular bundles are separated by wide parenchymatous primary rays, can only exist in plants with closed vascular systems. As closed systems are almost certainly in the minority, the current conception of a typical dicotyledonous stem appears to require some revision.

Apart from a general tendency for the more specialized herbaceous families to display closed systems, there is no close correlation between the type of vascular system and the habit of the plant. Thus *Casuarina*, although woody, has a closed vascular system and a tardy development of interfascicular tissue, while many herbs have open systems and exhibit a continuous ring of xylem and phloem almost from the beginning. A herb of this type is to all intents and purposes a woody plant which never develops beyond the first annual ring, and should be clearly distinguished from those more typically herbaceous forms in which interfascicular tissues develop late (for example, *Helianthus*) or not at all (for example, *Petasites*).

Both open and closed vascular systems display great variety in phyllotaxy and in the number and position of the foliar traces. These differences offer a rich and unexplored field for the characterization of taxonomic groups. We are here concerned with matters of more general interest.

The particular type of open system shown in Fig. 1 appears to be of outstanding importance. The 'stem bundles', which are indefinitely continued upwards

and which give rise to the traces as lateral branches, are here equal in number to the orthostichies of the regular spiral phyllotaxy, and each leaf has three traces, each lateral trace being separated from the corresponding median one by a single stem bundle. Any vascular system exhibiting these features may be called an 'acacian' system. (It should be noted that the concept of a 'stem bundle' is quite distinct from the 'cauline bundle' of the older anatomists.) The figure presents the acacian system in a somewhat idealized form. In reality, the length of the free course of a trace is subject to wide and random variation, nor is it a constant rule for the traces to depart from the stem bundles in one direction only. In a description written in the old style the essential features of the acacian system would be submerged beneath a welter of detailed information about the idiosyncrasies of individual traces.

Detailed evidence has been presented elsewhere^{3,4} in support of the view that the acacian vascular system was the ancestral form for the Leguminosæ. This interpretation is based partly on the occurrence of acacian systems more particularly in those genera which are judged on grounds of floral structure to be primitive, but principally on the fact that acacian forms occur in many tribes which also have non-acacian representatives, the acacian forms in different tribes resembling one another much more closely than do their non-acacian allies. Any interpretation which does not regard the acacian forms as primitive involves the assumption of numerous convergent evolutionary trends, and is therefore to be rejected unless upheld by a considerable body of new facts.

It would be premature to attempt to extend this reasoning to the dicotyledons as a whole, but as a working hypothesis to act as a spur to further research the idea that the primitive angiosperm had an acacian vascular system has much to recommend it. At least, it does not conflict with any of the known facts, and in several instances it accords very well with the available data. Thus, for example, the Euphorbiaceæ are mostly acacian, the known exceptions being the specialized and quite dissimilar herbaceous genera *Ricinus* and *Mercurialis*.

It may reasonably be expected that of all woody dicotyledons with alternate leaves some 60-70 per cent will be found to have acacian systems, a large proportion of the remainder being derived from the acacian type by the omission of the lateral traces. Scarcely anything is known concerning the woody forms with opposite leaves, but it seems quite certain that among the herbaceous dicotyledons the vascular systems display such diversity that no type can be pointed out as being specially abundant.

Examination of Fig. 1 will show that the adjacent lateral traces of two successive leaves are on the same vertical line, so that the insertions of the leaves, as seen in a plan view of the shoot, would just meet. In such cases the insertions may be said to be 'in contact'. Other conditions also occur. In a considerable number of cases the insertions of successive leaves overlap, as seen in plan view ('interlocked' insertions), while in others they fail to meet ('separated' insertions). The interlocked condition of the insertions, though often a serviceable taxonomic character, does not appear to be of any great general interest. The separated arrangement, however, is closely linked with some problems of phyllotaxy.

In all the plants so far investigated in which the insertions are in contact, the spiral phyllotaxy is perfectly regular, both internode length and angular

divergence being practically constant. This is also often the case when the insertions are separated. A number of cases are known, however, where separated insertions are associated with a more or less complete breakdown of the spiral leaf-succession. In *Lespedeza sieboldi*, *Amorpha canescens*, and some species of *Erythrina*, shoots can be found in which the arrangement of the leaves appears to be governed solely by the consideration that two leaves cannot occupy the same position. In some instances indications of a verticillate arrangement can be found. Occasionally the whole transition from a spiral to a whorled (or decussate) arrangement may be found in a single species. Thus in *Spartium junceum* the plumular shoot has a spiral of leaves with the insertions, or at least the lower ones, in contact, while the lateral branches have separated insertions and decussate phyllotaxy. It appears that in some trees the normal shoots have insertions in contact and spiral phyllotaxy, while the suckers have separated insertions and

tend to form whorls. Although it is possible that whorls have also arisen in other ways, it seems probable that most verticillate phyllotaxy is merely a consequence of the separation of the insertions. The prevalence of opposite leaves in so many families of Sympetalæ may well be due to the fact that each leaf has only a single trace, so that the insertions are necessarily separated.

It is now nearly ninety years since the appearance of the first important memoir on this aspect of plant anatomy, yet the subject is still in its infancy. During the last few decades there have been signs of an awakening interest in the morphology of the angiosperm shoot, and it is reasonable to hope that the primary vascular system will in future receive its fair share of attention.

¹ *Beitr. wiss. Bot.*, 1 (1858).

² *Amer. J. Bot.*, 1, 303 (1914).

³ *Ann. Bot.*, N.S., 9, 141 (1945).

⁴ *New Phytol.*, 45, 145 (1946).

NEWS and VIEWS

Universities of the Argentine: Retirement of Prof. Bernardo A. Houssay, For.Mem.R.S.

THE Universities of the Argentine have at present lost their autonomy, the Government having placed at the head of each faculty an 'intervening delegate', who has taken over administration and direction in accordance with the Government's wishes. Basing his action on the recent decree of the executive power controlling clauses in the University statutes concerning the age limit for retirement of professors, the 'intervening delegate' of the Faculty of Medical Sciences in the University of Buenos Aires has informed Dr. Bernardo A. Houssay, titular professor of physiology, who has a world-wide reputation in the field of endocrine research, that he is now liable for retirement and is forthwith 'relieved of his post'. Dr. Houssay is fifty-nine years old. His forcible retirement was followed by a boycott by the students of the physiology classes, and many resignations of members of the staffs of Argentine universities, including Dr. E. Braun Menendez, Dr. V. Foglia, Dr. L. Leloir and Dr. J. T. Lewis.

It will be recalled that Prof. Houssay was relieved of his post some time ago by Government decree, but this action was afterwards declared illegal and Houssay was judged never to have left his university position. At that time an independent Instituto de Biología y Medicina Experimental was founded at Calle Costa Rica 4185, Buenos Aires, with widespread financial support not only in the Argentine but also the United States of America and other countries, which was staffed by Dr. Houssay, Dr. Braun Menendez, Dr. Foglia, Dr. J. T. Lewis, Dr. O. Orias and others. When Dr. Houssay returned to his university post after his first dismissal, the Instituto de Biología y Medicina Experimental was still maintained as an independent unit, and it is to be presumed that Dr. Houssay has now returned to the post of director of this Institute.

Economics at Leeds: Prof. J. Harry Jones

PROF. J. HARRY JONES has just retired from the chair of economics in the University of Leeds which he has held for the past twenty-seven years, and has been made emeritus professor. He has also been

given the honorary degree of doctor of laws of the University of Wales. Prof. Jones has rendered outstanding services to the University of Leeds both as a leading authority in his subject and in the development of university policy, and has built up a strong Department of Economics and Commerce. Prof. Jones went to Leeds with the highest academic qualifications in economics from University College, Cardiff, and with valuable experience both of university teaching, at Liverpool and Glasgow, and of Government war-time work in the Ministry of Munitions and the Ministry of Labour. He thus brought to his work first-hand practical knowledge as well as great gifts of theoretical analysis. His outlook has been liberal, and in his teaching, writings and research he has maintained the highest standards of academic integrity.

Prof. Jones' work has received national recognition by his membership of Royal Commissions and Government committees, including the Royal Commission on the Geographical Distribution of the Industrial Population, and he was chairman of the Nova Scotia Royal Commission of Economic Enquiry in 1934. He has served on committees of the Economic Advisory Council, on trade boards, and on the West Riding Agricultural Wages Committee. The problems of finance have always been one of his main interests, and in this connexion he has maintained close contact with the professional organisations of bankers and accountants; he has also made a special study of the economics of the coal mining industry and of building societies, and has recently prepared a report on road accidents for the Government. Prof. Jones has contributed a number of papers to the Royal Statistical Society, has been a member of its council, and was awarded its Guy Silver Medal in 1934; he has also served as president of Section F of the British Association. His publications include books on "Social Economics" and "The Economics of Private Enterprise".

Imperial Institute of Entomology: Dr. S. A. Neave, C.M.G., O.B.E.

THE retirement of Dr. S. A. Neave last July from the directorship of the Imperial Institute of Entomology will be much regretted by entomologists and

others in many countries. He was appointed assistant director of the then Bureau of Entomology in 1913, and filled that position until July 1942, when he succeeded Sir Guy Marshall as director of the present Institute. Dr. Neave's name is inseparably associated with the growth and outstanding reputation of the Institute's Publication Office. In particular the *Review of Applied Entomology* and the *Nomenclator Zoologicus* (in four volumes) are constant reminders of the debt which not only entomologists but also general zoologists owe to Dr. Neave. In addition, during the four years he was director of the Institute, Dr. Neave supervised the production of the bulky "Insecta" part of the annual *Zoological Record*, besides editing the *Bulletin of Entomological Research*. He carries with him the good wishes of a wide circle of entomologists, and many others, on his retirement. He is succeeded as director of the Imperial Institute of Entomology by Dr. W. J. Hall, who was appointed assistant director in 1944 (see *Nature*, 153, 649; 1944).

Astronomical Institute at Amsterdam:

Prof. A. Pannekoek

THE Astronomical Institute of the University of Amsterdam has a unique reputation in the astronomical world as a centre for research in both stellar physics and stellar statistics. This is due to the work of its first director, Prof. A. Pannekoek, whose retirement has just been announced (*Nature*, Nov. 9, p. 662). Noteworthy among his investigations was that which first established a wide dispersion in the absolute magnitudes of the hot, B-type stars, and so led to the now generally accepted view of the existence of these stars in highly localized clusters. Equally significant was his work on Saha's theory of thermal ionization and on the theory of stellar line contours. He is one of the three pioneers—McCrea and Unsöld being the others—responsible for developing a wholly deductive theory of the model stellar atmosphere, while his more recent spectroscopic work on the brighter Cepheids has already led to interesting developments in spectrophotometric technique.

Prof. H. Zanstra

PROF. PANNEKOEK's successor as director of the Institute is Prof. H. Zanstra, well known in Great Britain as the first Radcliffe Travelling Fellow in astronomy. Zanstra's work has been inspired by a keen physical insight, and has led to the widely accepted quantitative theory of the luminosity of the gaseous nebulae. Equally significant have been his investigations of the dynamics of radiation pressure in diffuse and planetary nebulae, and his discussion of the probable expansion of the latter objects. In recent years his interest has been awakened in solar physics, and he has been responsible for investigations on the hydrodynamics of solar prominences and the polarization of resonance radiation from the limb of the sun. In Prof. Zanstra the Institute has a director who may be expected to maintain its great reputation.

Fourth Centenary of the Birth of Tycho Brahe

THE Rev. P. Antonio Due Rojo, S.J., has an article with the title, "En El Cuarto Centenario Del Nacimiento de Tycho-Brahe" in *Euclides* of January 1946, No. 59, which briefly outlines the main features in the astronomical work of Tycho Brahe. As a practical astronomer, Tycho realized that the question of the true system of the world could be settled only by amassing evidence from the positions and motions

of the planets. His long series of observations made possible the discovery of Kepler's laws of planetary motion and also the final proof of the heliocentric theory—a theory which Tycho himself had rejected. The author refers to his relations with astrology, and mentions one of his books which was published after his death, with the expressive title, "Tychonis Brahe de disciplinis mathematicis oratio, in qua simul astrologia defenditur et ab objectionibus dissentientium vindicatur". A similar vindication of astrology was the subject of one of his conferences in the University of Copenhagen, and his position at the Court required an annual compilation of prognostications for the year following as well as horoscopes of each member of the royal family. It is interesting to know that the foundation stone of Uraniborg was laid on August 8, 1576, at a time when Jupiter and Regulus were in conjunction and the moon was in Aquarius, that is, when the celestial influences were most favourable. Whatever may have been the real views of some eminent astronomers on the subject, necessity sometimes compelled them to cast horoscopes as a means of livelihood. A well-known instance of this is seen in the case of Kepler, who cast horoscopes for princes and other important people. Probably astrologers in those days were able to ease their consciences by quoting the saying of the classical poet, "Mundus vult decipi: ergo decipiatur". In spite of his astrological practices, Tycho stands before the world as a renowned astronomer and an example of what can be accomplished by patient and persistent observation.

University Grants Committee

Sir Robert Greig and Sir Henry Tizard have resigned from the University Grants Committee. The Chancellor of the Exchequer has appointed the following new members: Miss D. Dymond, principal of Portsmouth Training College; Mr. H. L. Elvin, principal of Ruskin College, Oxford; Mr. H. S. Magnay, director of education, Liverpool; and Prof. E. K. Rideal, director of the Davy Faraday Laboratory, Royal Institution. These appointments broaden the membership of the committee by going outside the strictly academic field of university education.

Commonwealth Travelling Fellowship for the Royal College of Surgeons

A PROMINENT New Zealand industrialist has made an anonymous gift to the Royal College of Surgeons of England for the endowment of a Commonwealth Travelling Professorship. The endowment will provide an income of about £2,000 a year, and the benefaction is to be known as a gift from "A New Zealand Family". A Commonwealth professor will be appointed each year and will generally be a prominent physician, surgeon or scientific worker resident in Great Britain or in Australia or New Zealand. The appointing authorities are also empowered, however, to elect as a professor a distinguished teacher from one of the other Dominions. The professor will be required to travel from the country where he or she is ordinarily resident to Great Britain, or to Australia and New Zealand, and to any other Dominion of the British Commonwealth, for the purpose of assisting in the advancement of medical science either by lecturing, teaching or engaging in research. It is hoped that the institution of this professorship will not only lead to the establishment

of closer links between scientific workers in the Dominions and in the older seats of learning and centres of research, but also that the people of all nations will benefit. It is also hoped that it will be an important contribution to Imperial unity.

Scientific Approach to Foreign Affairs

IN the latest and final "Looking Forward Pamphlet" (No. 9) of the Royal Institute of International Affairs, under the title "Foreign Affairs and the Public", Mr. John Price deals with the connexion between foreign affairs and the daily interests of the individual citizen. Explaining first the subject-matter of foreign affairs, he shows how the human element as well as questions of trade and security enter into it. Considerations of human conduct and morality complicate international affairs, and the greatest difficulties arise not from the problems themselves but from the policies of nations and governments determined to pursue their selfish ends by every possible means. The study of international affairs is not an exact science, nor concerned with the relations between nations in the abstract: it is a study of human affairs. That must be remembered in appraising the machinery for the conduct of foreign affairs, whether at the national or the international level. This machinery is well reviewed by Mr. Price in his next section, which gives a very clear picture of the limitation and purposes of world organisation. The new international organisations are being established in one sphere after another where the need for them is clearly felt, and machinery for collaboration at different levels and in all spheres must be provided if the tasks of maintaining security and promoting peace are to be accomplished.

The purpose of security, however, is to provide the conditions in which civilization and culture can prosper, and Mr. Price then reviews both the methods and policies by which foreign affairs are conducted, and emphasizes finally the need for pursuing actively policies based upon international co-operation and world organisation. The fundamental difficulty the nations have to face is the reconciliation of national self-interest with the common good of the world as a whole. That is why public interest in foreign affairs is so important. We need experts, but we need also citizens who are able to see clearly, to judge shrewdly and to realize whether they are being given the essential facts. We have to ensure that there are enough experts in the foreign service, and that they possess the requisite qualifications; but it is equally important that the ordinary citizen should have access to accurate, abundant and up-to-date information to enable him to understand more about the problems and difficulties, the needs and aspirations, the history and traditions of other countries and nations.

East African Industrial Research Board

THE third annual report of the East African Industrial Research Board (P.O. Box 1587, Nairobi. 1s. 6d.) covers the year ended December 31, 1945, and includes, in addition to the chairman's report, those of the Tanganyika Industrial Committee and the Uganda Industrial Committee. Dr. A. J. V. Underwood continued to serve as overseas consultant, and the main preoccupation of the Board has been planning for the future of industrial research in East Africa. So far the governments concerned have not all accepted the proposals formulated by the chairman for an East African Department of Industrial Research

and Development. The Board's research organisation continued on its war-time basis, but staff difficulties are expected to restrict its services in 1946. The technical publications of the Board appear to be meeting a public need, and a small technical library has been built up. While much of the time of the Chemical Laboratory has been occupied by analytical work, important work has been done on the development of phosphatic fertilizers, and a new product, 'Silicophosphate', is now undergoing extensive field trials. Methods of mining salt from the salt lakes of Uganda have been under examination, and the improved quality of domestic pottery is largely due to the work of the Ceramics Branch. Attention was also given to the improvement of oil milling and soap manufacture, and draft specifications for soaps were prepared by the Panel on Oils and Fats and later adopted by the Government of Kenya.

The report of the Tanganyika Industrial Committee reviews the activities of the Hones factory, including slate pencil manufacture, which was closed on October 15, and of the Totaquina factory where a study of the quality and efficiency of extraction has established the relation between the total alkaloidal content of the bark and the quality and efficiency of extraction of the total alkaloids. The Uganda Industrial Committee is being disbanded this year, and the pottery, which did not enjoy a prosperous year, will then come under the direction of the Geological Survey.

Proceedings of the Academy of Sciences, Vienna

VOLUMES 148-151 inclusive, covering the years 1939-42, of Section IIa of the *Proceedings* of the Academy of Sciences, Vienna, in which are published articles on astronomy, mathematics, meteorology, physics and technology, have recently been received. The number of articles contained in each volume is substantially the same; but this is considerably less than for volume 147, for 1938. A reduction in the page size of the pamphlet was made in 1940, and, in addition, in the following year, paper of an inferior and darker quality was introduced. The majority of the articles are theoretical. Of the experimental articles, those on the light properties of stars by K. Graff, and the "Communications from the Institute of Radium Research", of which several appear in each volume, are worthy of special mention. As is to be expected, the latter deal mainly with the properties of uranium and thorium, fission products and the effects of neutron bombardment. The purely mathematical papers include one on Laguerre's polynomials by A. Erdélyi, on the Euler-Maclaurin series and Bernoulli's numbers by A. Klingst, and on differential geometry by K. Strubecker.

Modern Views on Geography

IN an inaugural address at the University of Liverpool entitled "The Theory and Practice of Geography" (University Press of Liverpool; London: Hodder and Stoughton, Ltd. 1s. net), Prof. H. C. Darby stressed the changes in ways of thought of the late eighteenth and early nineteenth centuries which had made place for the modern geographical outlook. He cited specially the widening of the scope of history, the rise of the social sciences and particularly the writings of F. Le Play, and the voyage of the *Beagle* with Darwin's stress on the importance of environment. Thus there was prepared the way for such geographical writers as A. von

Humboldt and K. Ritter. In spite of the great progress made in geographical thought in recent decades, there is a noticeable lack, at least in English, of objective geographical studies of most parts of the world. British geography has progressed more on the study of topics than that of regions. Prof. Darby spoke of the importance of more regional study, especially with a historical bias, since the character of a region is based not merely on physical and economic facts, but also on the legacies of successive generations of its inhabitants.

Documentation in Switzerland

A SECOND, completely revised and augmented edition of "Führer durch die Schweizerische Dokumentation", by Theodore van Schelven (Amsterdam: Kosmos Publishing Co., Keizersgracht 133. 1 dollar), has now been published by the Swiss Association for Documentation. The pamphlet has proved of considerable value to Swiss research workers during the war years, since it quotes collections containing literature lacking in the large Swiss scientific libraries and which could not be included in the general catalogue of the Swiss National Library. The new edition lists 227 documentation centres arranged by subject according to the Universal Decimal Classification, together with alphabetical name, subject and place indexes, and a list of users of the Universal Decimal Classification. The introduction includes brief notes on the Swiss Association for Documentation, the Swiss Association of Librarians, the general catalogue and information service of the Swiss National Library, Berne, on documentation terminology, the standardization of documentary aids and a bibliography of publications of Swiss authors on documentation, bibliography and the decimal classification.

Silicon Carbide Non-ohmic Resistors

DURING the past decade, resistors having silicon carbide as basic ingredient and characterized by a striking departure from Ohm's law—the current passed being proportional to the fourth or fifth power of the applied voltage—have become available commercially and are now widely used in many fields of electrical engineering. Their development was first stimulated by the requirements of surge diverters (lightning arresters) for overhead power transmission lines, but success in this application had led to their use for the protection, at much lower voltages, of the highly inductive coils found in electrical machinery, contactors, clutches, brakes, relays, etc. An important advantage arising from the limitation of the peak voltage developed when such coils are disconnected from the supply is the reduction of the sparking at opening contacts, and of the radio interference to which such sparking gives rise. This method of spark quenching has received particular attention in connexion with telephone relays, where the preservation of contacts is of great importance. Silicon carbide resistors have also found application for the protection of radio transmitting and receiving circuits and of electrical instruments, and for scale modification in the latter; in metadyne systems, where they permit practically any desired main motor characteristic to be obtained; and in non-linear bridge circuits. The characteristics and limitations of these resistors, and the principles governing their application, are discussed in a recent paper by Messrs. F. Ashworth, W. Needham and R. W. Sillars (*J. Inst. Elect. Eng.*, 93, Part 1, No. 69; Sept. 1946), with which is associated an extensive discussion.

Research on Multiple Sclerosis

THE Association for Advancement of Research on Multiple Sclerosis, the address of which is New York Academy of Medicine Building, Fifth Avenue and 103rd Street, New York 29, N.Y., has been formed by a group of multiple sclerosis patients, with their many friends and relatives, in co-operation with some of the leading neurologists of North America. Its aims are: (1) co-ordination of research efforts on multiple sclerosis; (2) collection of statistics on its prevalence and geographical distribution; (3) to act as a clearing house for information on this disease; (4) education of the public on the problem of multiple sclerosis; (5) collection of funds to stimulate and support research on multiple sclerosis and allied diseases. For the present, the Association proposes to conduct a membership drive for the enrolment of multiple sclerosis patients as well as the public, in an endeavour to obtain more definite statistical data on the prevalence of the disease. Dr. Tracy Jackson Putnam, director of Services of Neurology and Neurological Surgery, Neurological Institute of New York, is the honorary chairman of the Association.

Institution of Civil Engineers

SIR WILLIAM HALCROW, in his presidential address to the Institution of Civil Engineers on November 5, reviewed the accomplishments of the Institution, more particularly during the past fifteen of the 128 years that it has been in existence. Not every engineer will agree with Sir William's opinion that too much reliance should not be placed on theoretical knowledge. Engineering is an applied science, and therefore the provision of facilities for practical training, as distinct from practical experience, cannot receive too much attention from the Institution; but it is impossible for the engineer to have too much knowledge of the fundamentals or theoretical basis of his science. The civil engineer's record during the War when, as Sir William points out, 'Mulberry' and 'Pluto' were designed, would have been even more spectacular if fundamental knowledge, essential in dealing with new and complex problems, had been more widespread.

Another matter of considerable moment, dealt with by Sir William in his address, was the difficulty met with to-day in presenting the views of the profession as a whole on matters of public interest, due to the large number of engineering institutions which exist. While the Institution's present policy of setting up sectional divisions specializing in the various branches of professional work may make unnecessary the creation of more institutions, it is unlikely to do much to encourage the existing smaller institutions to amalgamate. The value of amalgamation which would enable engineers, who should form a most influential section of the community, to speak with one voice, is recognized by all but a very small minority. That small minority, however, inevitably includes the most influential and hard-working members of the smaller institutions, who are naturally governed by a sense of loyalty to their own organisations. It will need a measure of self-sacrifice and a sense of wider loyalty to the profession as a whole to right the position.

Officers for 1946-47

THE following have been elected officers for 1946-47 of the Institution of Civil Engineers: *President*, Sir William Halcrow; *Vice-Presidents*, Sir Frederick

Cook, Sir Reginald Stradling, Sir Jonathan Davidson, Sir Roger Hetherington; *Other Members of Council*, Mr. H. E. Aldington, Sir Stanley Angwin, Mr. D. B. Brow (India), Mr. W. S. Cameron, Mr. F. M. Corkill (New Zealand), Dr. W. H. Glanville, Mr. A. Gray (Canada), Mr. G. L. Groves, Mr. H. Hamer, Dr. E. J. Hamlin (South Africa), Mr. A. C. Hartley, Mr. G. H. Humphreys, Mr. L. Leighton, Mr. M. G. J. McHaffie, Mr. M. S. Moore (Australia), Mr. W. H. Morgan, Dr. H. J. Nichols (India), Mr. C. M. Norrie, Sir Leonard Pearce, Prof. A. J. S. Pippard, Mr. V. A. M. Robertson, Mr. W. P. Shepherd-Barron, Mr. W. K. Wallace, Mr. D. M. Watson, Sir Arthur Whitaker; *Past-Presidents*, Sir John Thornycroft, Dr. David Anderson, Mr. F. E. Wentworth-Sheilds, Sir Peirson Frank; *Secretary*, Mr. E. Graham Clark.

Curare in Anæsthesia

THE Anæsthetics Committee, jointly appointed by the Medical Research Council and the Royal Society of Medicine, is considering the standardization of curare. There are on the market at present two preparations for use in anæsthesia, one amorphous and one crystalline, but both depend for their activity on *d*-tubocurarine chloride; the co-existence of preparations of different potency is a source of danger and may result in serious accidents. The amorphous preparation, "Intocostrin", has, in fact, about one-quarter the activity of the pure crystalline material. There is also some evidence of wide differences in the reactions of the patient, depending to some extent on the state of health of the individual at the time. The Committee, therefore, considers it advisable, in the present state of knowledge, to base the dose on the individual reaction to an initial small injection rather than on any dose/weight ratio. In the average healthy adult this initial dose could be 10–15 mgm. of crystalline *d*-tubocurarine chloride or 40–60 mgm. of "Intocostrin". In one otherwise healthy man with a recent perforated gastric ulcer, so little as 5 mgm. of the crystalline material produced adequate muscular relaxation, and 15 mgm. would probably have been a considerable overdose.

The Anæsthetics Committee has been reconstituted with the following membership: Dr. C. F. Hadfield (chairman), Prof. F. H. Bentley, Dr. C. Langton Hewer, Mr. R. Vaughan Hudson, Dr. H. King, Prof. R. R. Macintosh, Dr. F. C. MacIntosh, Dr. M. D. Nosworthy and Dr. G. S. W. Organe (secretary).

Museums and the Development of Visual Education

A BRIEF report of a paper entitled "Museums and General Education", read by Mrs. Jacquetta Hawkes (Ministry of Education) on the occasion of the Museums Association Conference last July, appears in the *Museums Journal* of October 1946, p. 118. Mrs. Hawkes said that at the present time there is in the educational world a great vogue for the use of visual teaching methods. Unfortunately, visual education often means films mainly intended for factual instruction. Museums are uniquely qualified for visual education, because they can offer real things that can be handled. Mrs. Hawkes went on to suggest that museums should design exhibits to give intellectual instruction, offering objects without comment. By this encouragement of the intuitive sense and training in the judgment of individual quality, Mrs. Hawkes believes that museums can make their most valuable and distinctive contribution to the content of education. If her words reflect the

attitude of the Ministry of Education, they form a happy augury for the improvement of the museum services of Britain, and it is highly important that this interest should be further explored by leading museum authorities.

Jubilee of the Discovery of the Electron

THE fiftieth anniversary of the discovery of the electron by Sir J. J. Thomson will occur next year. To mark this jubilee and to demonstrate the tremendous influence such an advance in pure physics may have on the life of the community, the Physical Society and the Institute of Physics are jointly arranging a series of meetings and other functions to take place during September 25 and 26, 1947, in London. A special exhibition, which will remain open to the public for several weeks, will be held at the Science Museum, South Kensington, and will show the development of a vast range of modern industrial equipment from its earliest experimental origins.

Announcements

THE eleventh Liversidge Lecture of the Chemical Society will be delivered by Prof. Harold C. Urey, of the Institute of Nuclear Studies, University of Chicago, at the Royal Institution, London, W.1, on December 18 at 7.30 p.m. He will speak on "Some Problems in the Separation of Isotopes".

SIR ALEXANDER FLEMING has been awarded the honorary gold medal of the Royal College of Surgeons in appreciation of his distinguished work and particularly in recognition of his discovery of penicillin.

MR. KENNETH CARTER has been appointed secretary of the Therapeutic Research Corporation of Great Britain, Ltd., in succession to Dr. Frank Hartley.

THE Cambridge Philosophical Society announces that the adjudicators for the Hopkins Prize have made the following awards for the period 1933–39: to Prof. J. D. Cockcroft, director of the Atomic Energy Research and Development Establishment at Harwell, for researches on the artificial transmutation of elements; and to Prof. E. A. Milne, Rouse Ball professor of mathematics in the University of Oxford, for researches on stellar structure and cosmology.

PROF. H. HARTRIDGE, professor of physiology at St. Bartholomew's Hospital Medical College, University of London, will deliver the Christmas Lectures "adapted to a Juvenile Auditorium" at the Royal Institution on December 28, 31, January 2, 4, 7 and 9; he will speak on "Colours and How We See Them".

MR. N. J. SCORGIE, reader in the Department of Animal Husbandry at the Royal Veterinary College, has been appointed to the Courtauld chair of animal husbandry, veterinary hygiene and dietetics in the College in succession to Prof. W. C. Miller, who resigned the chair in order to take up an appointment as director of the Equine Research Station of the Veterinary Educational Trust.

DR. W. L. WATERHOUSE, reader in the Faculty of Agriculture of the University of Sydney, has been appointed research professor in agriculture in recognition of his work in cereal pathology.

LETTERS TO THE EDITORS

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

An Antibacterial Substance from *Arctium minus* and *Onopordon tauricum*

EXTRACTS of *Arctium minus* Bernh. (a plant which was erroneously listed in a previous publication¹ as *Arctium lappa* L.) were found by Osborn² to contain an antibacterial principle. In May 1945 the substance responsible for the antibacterial action of the extracts was isolated from the radical leaves of *Arctium minus* Bernh. in a crystalline form. More recently, the same substance has been isolated from first-year plants of *Onopordon tauricum* Willd., a southern European species belonging to the same section of Compositae as *Arctium*.

The substance was isolated from *Arctium minus* Bernh. in the following manner. An aqueous extract was made by grinding the fresh leaves of the plant with sand, in the presence of water, and pressing the fluid through silk. The extract was adjusted to pH 3, boiled and centrifuged. The supernatant liquid was extracted three times with an equal volume of ether, and the combined ethereal solutions passed through a column of acid-washed (pH 5) Brockmann alumina. The active substance passed through the column and was collected in the percolate. From the most active fractions of the percolate, crystals of the antibacterial substance were deposited on standing in the ice-chest; further crystalline material was obtained from the less active fractions by concentrating these *in vacuo*. The substance was recrystallized by the addition of ether to a concentrated solution of it in warm ethyl acetate.

A crystalline substance with antibacterial properties was isolated from *Onopordon tauricum* by a procedure similar to that used for extracting the active principle from *Arctium minus* Bernh. X-ray powder photographs showed that the two substances were identical.

When tested by the cylinder-plate method² on a plate seeded with a 24-hour culture of staphylococci diluted 1:1,000, a solution containing 0.5 mgm. per ml. of the crystalline substance in 10 per cent aqueous ethanol gave a zone of inhibition of about 20 mm. diameter. A solution containing 2 mgm. per ml. of the substance produced no inhibition on a plate seeded with *Bact. coli*.

The active substance is neutral and crystallizes in small orthorhombic plates, m.p. 57–59°. It is optically active, $[\alpha]_D^{20}$ in ethanol being +161° and $[\alpha]_D^{20}$ in acetone +157°. It is readily soluble in ethanol, acetone, ethyl acetate, or chloroform, sparingly soluble in water or ether and insoluble in petroleum ether.

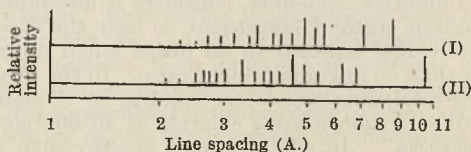
The results of elementary analysis of the substance (C, 64.2; H, 7.1) indicated that it had the empirical formula C_8H_8O . X-ray crystallographic measurements gave the following unit cell dimensions: $a = 12.3$ A.; $b = 7.0$ A.; $c = 20.5$ A. The space group was found to be $P2_12_12_1$; and the number of molecules in the unit cell (n) was 4. Values obtained for the density of the crystals averaged 1.27. The molecular weight calculated from these figures was 339 ± 12 , or a submultiple of this. The equivalent weight of the substance, determined by alkaline titration, was 325. From these data it appeared that

the molecular formula for the substance was $C_{16}H_{24}O_6$ (mol. wt. = 336).

The substance contained one C-methyl group, but no methoxyl. Hydrogenation in the presence of palladium-charcoal catalyst resulted in the uptake of eight atoms of hydrogen per mole and loss of antibacterial activity. In chloroform-carbon tetrachloride solution the substance absorbed eight atoms of bromine per mole. A solution of the substance in 10 per cent aqueous ethanol gave no coloration with ferric chloride and only a faint opalescence on addition of Brady's reagent.

The active substance was stable to dilute acid but was inactivated by dilute alkali. On shaking with 0.1 N baryta, it dissolved slowly with the liberation of one acid group. A second acid group was liberated gradually when the alkaline solution was allowed to stand at room temperature, and more rapidly on heating at 100°. Back titration of the solution immediately after the substance had dissolved, using phenolphthalein as an indicator, indicated an apparent equivalent weight of 325; after heating in alkaline solution for 45 minutes at 100°, the back titration value corresponded to an equivalent weight of 170.

These properties are compatible with a structure containing four double-bonds of aliphatic character, an ester group and a lactone ring. The substance did not give the Legal nitroprusside reaction for $\beta\gamma$ -unsaturated lactones having an α -hydrogen atom³, however, nor, like certain $\alpha\beta$ -unsaturated lactones, did it reduce, at room temperature, ammoniacal silver nitrate containing caustic soda.



POWDER PHOTOGRAPH LINES OF (I) AND (II)

On keeping in air the antibiotic underwent a change, and after several weeks the substance did not melt at 200°, was pseudocrystalline and was insoluble in solvents such as ethyl acetate. The figures obtained on elementary analysis indicated that this change was the result of an oxidation. When stored under petroleum ether, the antibiotic could be kept unchanged for a considerable time.

Cavallito, Bailey and Kirchner have also isolated an antibacterial substance from samples of *Arctium minus*⁴. Their substance (I) had the same empirical formula (C_8H_8O) as the product (II) described here. The two substances appeared to have similar solubilities, and both were sensitive to alkali and oxidized by atmospheric oxygen; but large differences between the values for the melting point and optical activity of (II) and those reported for (I) indicated that they were not identical. The non-identity of the crystals was confirmed by a comparison of X-ray crystal photographs of (II) with those of a sample of (I) kindly sent to Dr. Heatley by Dr. Cavallito. The accompanying diagram shows the relative intensity of the powder photograph lines of (I) and (II) plotted against the spacing of the lines in angstrom units. The two substances had a very similar activity against *Staph. aureus* when tested by the cylinder-plate method.

On the basis of titration values for the acid liberated on treatment of the substance with alkali, and of

analytical data for an isopropylamine derivative, Cavallito *et al.* assigned to their product the molecular formula $C_{15}H_{20}O_5$. X-ray crystallographic analysis of the sample of (I) in our possession, which was in the form of orthorhombic needles, gave the following results: $a = 12.3 \text{ \AA}$; $b = 11.0 \text{ \AA}$; $c = 13.8 \text{ \AA}$; space group $P2_12_12_1$; $n = 4$; density 1.19; molecular weight 337 ± 12 (or a submultiple of this). This molecular weight corresponded to a molecular formula $C_{15}H_{24}O_6$, and suggested that (I) and (II) might be isomeric.

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¹ Osborn, E. M., *Brit. J. Exp. Path.*, **24**, 227 (1943).

² Heatley, N. G., *Biochem. J.*, **38**, 61 (1944).

³ Jacobs, W. A., Hoffmann, A., and Gustus, E. L., *J. Biol. Chem.*, **70**, 1 (1926).

⁴ Thiele, J., *Ann.*, **319**, 144 (1901).

⁵ Cavallito, C. J., Bailey, J. H., and Kirchner, F. K., *J. Amer. Chem. Soc.*, **67**, 948 (1945).

Factors Contributing to the Bacteriolytic Effect of Species of Myxococci upon Viable Eubacteria

ALTHOUGH the lytic effect of certain myxobacteria upon the true bacteria (eubacteria) has been known for some years¹⁻⁴, the mechanism of the process is imperfectly understood, and no one seems hitherto to have studied the possible production of antibiotic substances by the first-named group of micro-organisms. One of us (B. N. S.) has recently shown⁵ that some species of the Myxococcaceae undoubtedly cause lysis of living as well as dead bacteria, particularly upon solid non-nutrient media, but attempts to grow the lytic strains in suspensions of eubacteria in very dilute salt solution succeeded only when the latter were mostly non-viable. A possible explanation of this apparent anomaly is that the growth of the myxococcus concerned, upon dead bacteria or their products of disintegration, results in the production of a true non-enzymic antibiotic substance capable of killing viable eubacteria and so rendering them susceptible to lysis by the exocellular enzymes previously elaborated by the growing myxococci. If, therefore, an inoculum of myxococcal microcysts is made into a suspension of chiefly viable bacteria in a liquid, the minute amount of growth which can take place quickly upon the few dead bacteria will be insufficient to produce a high enough uniform concentration of antibiotic substance to kill any viable bacteria, and so growth ceases; but if an inoculation is made upon a dense mass of eubacteria on a solid medium, diffusion of metabolites is hindered and a high enough concentration of antibacterial substance is built up in the vicinity of the inoculum to kill some of the viable cells in that region and so enable growth of the myxobacterium to continue with progressive lysis of the eubacterial mass. We present below some evidence concerning the separation of the soluble non-enzymic antibiotic substance from the accompanying exocellular lytic enzymes which are active against non-viable bacteria only.

In one instance, namely, a strain of *M. virescens* derived from soil, the separation has been achieved by the simple expedient of growing the organism in a cell-free liquid medium of simple composition and isolating a crude non-enzymic antibiotic substance,

soluble in certain organic solvents, from the metabolic liquid by chemical means. This medium contained the amino-acids of a total acid hydrolysate of casein (c. 1 per cent) as sole source of carbon and nitrogen, and the optimum period of incubation for production of antibiotic substance was about ten days at 24° C. Incubation for a further fourteen days resulted in the total disappearance of antibacterial activity against *Staphylococcus aureus* for example, but the metabolic liquid still had good proteolytic activity against gelatin or the proteins of nutrient broth, and also bacteriolytic powers against dead bacteria, particularly of Gram-negative species. It had no action at all against suspensions of viable eubacteria made from a young nutrient agar slope. On the other hand, the crude antibiotic substance, which appeared to be associated with the valine-leucine fraction of the monamino-mono-carboxylic acids of the casein hydrolysate, had no proteolytic or bacteriolytic powers whatever. The most active preparation so far obtained completely inhibited the growth of *Staphylococcus aureus* at a concentration of 0.008 per cent in heart broth, but as this alcohol-soluble material consisted chiefly of valine and the leucines, the real antibiotic substance is probably of much greater activity than this.

It is a curious fact that the antibiotic substance acts much less powerfully upon Gram-negative than upon Gram-positive viable bacteria, while the reverse is true for the action of the lytic (proteolytic) enzymes upon dead bacteria. Hence it is not surprising that myxococci seem often to grow almost equally well on either kind of eubacteria, when presented as a partly living substrate upon solid media.

Our results will be reported in more detail elsewhere, but it is worth emphasizing a fact not generally known, namely, that myxococci can often be grown without difficulty in simple cell-free liquid media containing nothing more complex than amino-acids, and hence are amenable to the usual procedures employed for the study of the metabolism of moulds, yeasts and eubacteria, including the production of antibiotic substances.

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Oct 29.

¹ Pinoy, P. E., *Ann. Inst. Pasteur*, **35**, 487 (1921).

² Solntzeva, L. I., *Microbiologia (U.S.S.R.)*, **8**, 700 (1939).

³ Beebe, *Iowa State College J. Sci.*, **15**, 319 (1941).

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Pterygospermin: the Antibacterial Principle of *Moringa pterygosperma*, Gaertn.

THE discovery and use of penicillin and streptomycin has led to a search for similar antibiotics in other fungi and in higher plants. Systematic studies conducted in these laboratories¹ have shown the possibilities of a number of plant materials, reported in Indian medicine, which contain antibiotic substances effective against both Gram-positive and

Gram-negative organisms. In a recent publication² a plant antibiotic effective against even acid-fast organisms has been described. The present communication deals with the antibacterial properties of the extracts of the root of *Moringa pterygosperma*.

It was found that alcoholic extracts of different parts of *M. pterygosperma* showed pronounced antibiotic activity. The maximum activity was found to be in the roots. Apart from the work on the alkaloids^{3,4}, there is practically no information regarding the other principles present in the root of this plant. The separation of the antibacterial substance present in the root, which has been provisionally named 'pterygospermin', was therefore undertaken.

We adopted the following procedure. The root was cut into small pieces and extracted overnight in the cold with absolute alcohol. The alcoholic extract was then shaken well with active carbon, when 'pterygospermin' was completely adsorbed on the carbon. Elution with petroleum ether and subsequent removal of the latter in vacuum furnished an oil having a highly irritating smell. The oil is soluble in alcohol, and is the most active product yet obtained. The antibiotic is only slightly soluble in water, but forms an emulsion at high concentrations.

The accompanying table gives the antibacterial spectra of the substance isolated.

Organism	Dilution of antibiotic in media					
	1/20,000	1/30,000	1/40,000	1/50,000	1/75,000	1/100,000
1. <i>B. subtilis</i>	—	—	—	—	—	+
2. <i>S. aureus</i>	—	—	—	—	—	+
3. <i>B. dysenteriae</i> Flexner	—	—	—	+	+	+
4. <i>B. aerogenes</i>	+	+	+	+	+	+
5. <i>B. paratyphosus</i> B	—	—	—	+	+	+
6. <i>B. paratyphosus</i> C	—	—	+	+	+	+
7. <i>B. typhosus</i>	—	—	—	+	+	+
8. <i>B. coli</i>	+	+	+	+	+	+
9. <i>B. enteritidis</i>	—	—	+	+	+	+

— indicates no growth : + indicates growth.

Pterygospermin exhibits pronounced antibacterial activity against both Gram-positive and Gram-negative organisms, the former being inhibited at a dilution of 1 in 75,000 and the latter at 1 in 40,000. Preliminary experiments with an acid-fast organism *Mycobacterium phlei* show that the antibiotic inhibits the growth of this organism at a dilution of about 1 in 30,000. Further work regarding its activity against *M. tuberculosis*, and pathogenic fungi, its toxicity, use as a chemotherapeutic agent, as well as its properties as an antibiotic are in progress.

Our thanks are due to Prof. V. Subrahmanyam, Drs. N. N. De and K. P. Menon for their interest and valuable suggestions. We gratefully acknowledge generous support from the Council of Scientific and Industrial Research, under the auspices of which this work is being carried out.

R. RAGHUNANDANA RAO
 MARIAM GEORGE
 K. M. PANDALAI

Department of Biochemistry,
 Indian Institute of Science,
 Bangalore.
 Sept. 9.

¹ George, Mariam, *et al.*, in the press.

² Raghunandana Rao, R., *et al.*, *Nature*, 157, 441 (1946).

³ Ghosh, S., Chopra, R. N., and Dutt, A., *Ind. J. Med. Research*, 22, 785 (1935).

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Transfer of Phosphate by Coenzyme I

IN 1938, Ostern *et al.*¹ put forward a hypothesis according to which the function of coenzyme I is to transfer phosphate. It was suggested that the coenzyme in muscle, while taking up two hydrogen atoms in the pyridine nucleus through the addition of free phosphate, undergoes a phosphorolysis and is split into pyridin nucleotide and adenosine diphosphoric or triphosphoric acid. After the splitting off of phosphate, the adenine part of the coenzyme molecule recombines with the pyridine nucleotide part. In yeast, however, this mechanism was assumed to function in a somewhat different way, on account of the ability of the yeast enzyme to phosphorylate adenosine. Here also the hydrogenation would be accompanied by a hydrolysis of the coenzyme molecule followed by a transfer of the phosphate of the adenylic acid to other phosphate acceptors. In the regeneration of the coenzyme molecule occurring through the dehydrogenation of the pyridine nucleus, inorganic phosphate is said to be taken up. The validity of this hypothesis was tested in experiments *in vitro* by Meyerhof *et al.*². With the aid of radioactive phosphate they showed that the coenzyme I did not incorporate phosphate either at the hydrogen transfer or at the phosphate transfer.

We have carried out similar experiments with a

complete apozymase fermentation system containing radioactive orthophosphate. The coenzyme recovered after the evolution of a considerable amount of carbon dioxide did not show any radioactivity. Experiments *in vivo* with baker's yeast demonstrated, however, that radioactive phosphate introduced into the cells was incorporated into the coenzyme molecule (329 mgm. coenzyme isolated from 6 kgm. yeast treated in 5.5 litres of liquid for one hour with

0.1 milli-Curie showed an activity corresponding to 22.9×10^{-6} milli-Curie). The rate of this process was under certain conditions dependent on the rate of metabolism; but the phosphate exchange also took place in the absence of exogenous substrate at low temperature ($+4^{\circ}$ C.), though at a very slow rate. From this we conclude that the function of coenzyme I is to transfer phosphate, and that the systems *in vitro* used by Meyerhof *et al.* and by us do not reproduce the conditions in the living cells.

The analysis of the results is being continued, and a full account will shortly appear elsewhere.

P. E. LINDAHL B. STRINDBERG
 M. MALM B. M. LAGERGREN

Wenner Grens Institute for Experimental Biology,
 University of Stockholm. Oct. 13.

¹ Ostern, P., Baranowski, T., and Terszakowec, J., *Z. physiol. Chem.*, 251, 258 (1938).

² Meyerhof, O., Ohlmeyer, P., Gentner, W., and Maler-Lelbnitz, H., *Biochem. Z.*, 295, 396 (1938).

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APPOINTMENT (No. 1039) OF RESEARCH
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Applications are invited for appointment to vacant positions of Research Physicist on the staff of the Council's Division of Radiophysics, Sydney, N.S.W., Australia, for work in the following fields: (a) radio propagation, (b) vacuum physics, (c) applications of radio and radar techniques.

Qualifications: University degree in electrical engineering or in science, with mathematics and physics as major subjects, or equivalent qualifications, combined with considerable research experience.

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Applications referring to appointment No. 1039, clearly indicating field of work which the application covers and stating date of birth, nationality, present employment, particulars of qualifications and experience, accompanied by copies of not more than four testimonials, should reach the undersigned not later than December 30, 1946.

LEWIS LEWIS,

Secretary, Australian Scientific
Research Liaison Office,
Australia House,
Strand, London, W.C.2.

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H. CLAUGHTON,
Principal,
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E. G. BARNARD, M.A.,
Chief Education Officer.

COMMONWEALTH of AUSTRALIA

Council for Scientific and Industrial Research
Division of Aeronautics
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RESEARCH OFFICER (SENIOR PHYSICIST)

Applications are invited for appointment to a position of Principal Research Officer (Senior Physicist), Division of Aeronautics, Melbourne, Australia.

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Salary: Dependent on qualifications and experience, commencing salary will be determined within the range of principal research officer (£A796-£A940 per annum actual; four equal increments, first automatic, remainder discretionary). The above actual salaries include cost-of-living adjustment (at present an additional £A40 per annum). Note: Salary will commence from the date the successful applicant takes up duty in England, if required to do so, or one fortnight before scheduled date of departure for Australia, whichever is the earlier, and will be paid in sterling until embarkation for Australia; thereafter in Australian currency. Fares (including those of wife and family) to Australia will be paid.

Subject to a satisfactory medical examination, the appointee will be eligible to contribute to, and receive benefits from, either the Commonwealth Superannuation Fund or the Commonwealth Provident Fund.

Applications referring to appointment No. 1034 and stating date of birth, nationality, present employment, particulars of qualifications and experience, accompanied by copies of not more than four testimonials, should reach the undersigned not later than December 30, 1946.

LEWIS LEWIS,

Secretary, Australian Scientific
Research Liaison Office,
Australia House,
Strand, London, W.C.2.

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The Civil Service Commissioners invite applications for a limited number of appointments as Principal Scientific Officer in the Scientific Adviser's Department of the Air Ministry to deal with operational and administrative research problems in the Royal Air Force. These involve research into the characteristics of air operations, tactics, suitability of and requirements of technical equipment, together with the study of general economic, maintenance, manpower, and organization problems.

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A. W. CHAPMAN,
Registrar.

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London

Applications are invited from suitably qualified scientists for the post of Assistant (administrative) in the Secretariat provided by the Council for the Inter-Departmental Insecticide Committees. Candidates should possess a first- or second-class honours degree in zoology, botany, or chemistry, or its equivalent, and must have had varied experience of research and development problems, preferably in the entomological or plant pathological fields. Experience of the supervision of work of other investigators and some administrative experience are very desirable.

The salary of the successful candidate will commence at £640 and will be on the scale £640-£840 (including consolidation addition), and the selected candidate will be eligible to participate in the Federated System of Superannuation for Universities. The appointment of a promising candidate with less wide experience may be made, in which circumstance the salary will vary according to age and experience and will fall in the range £353-£590 (including consolidation addition).

Further particulars may be obtained from the Secretary, Agricultural Research Council, 6a, Dean's Yard, Westminster, S.W.1, to whom applications, together with copies of testimonials, should be addressed not later than December 9, 1946.

NATAL UNIVERSITY COLLEGE

(University of South Africa)

Department of Mechanical Engineering

Applications are invited for three Lectureships in Mechanical Engineering at Howard College, Durban. Lecturers are required to work under the general direction of the Professor, and the duties include lectures, drawing office work, and supervision of students in the laboratories. Lecturers will also be required to carry out research work in the department.

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Candidates should hold a degree and should have had workshop and drawing office experience. The successful applicants will be required to assume duty on March 1, 1947, or as soon as possible thereafter. Further particulars may be obtained from the Secretary, Universities Bureau of the British Empire, 24, Gordon Square, London, W.C.1.

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Candidates are required to possess a university science or engineering degree or its equivalent and, in addition, to have had satisfactory metallurgical experience in investigation or industry. The duties related to the appointment are those of the Senior Research Officer on the laboratory staff.

Application should be made on forms obtainable from the Secretary, Universities Bureau of the British Empire, 24, Gordon Square, London, W.C.1, from whom further particulars of the appointment may be obtained.

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Applications are invited for the following appointments:

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Applications for both posts should be made in writing as soon as possible and not later than December 9, 1946, to Secretary, Imperial College, South Kensington, S.W.7.

UNIVERSITY OF SHEFFIELD

Applications are invited for an Assistant Lectureship in the Department of Physiology. The appointment will be in the first instance probationary, on an annual basis. Salary £450 per annum in the first year, rising by £25 per annum to £500, with superannuation provision under the Federated Superannuation Scheme for Universities, and family allowance. The successful candidate will be expected to enter upon his duties as early in 1947 as possible.

Applications (three copies), including the names and addresses of three referees and, if possible, copies of two testimonials, should be sent to the undersigned (from whom further particulars may be obtained) by December 21, 1946.

A. W. CHAPMAN,
Registrar.

**UNIVERSITY OF SHEFFIELD
LECTURER IN MECHANICAL
ENGINEERING**

Applications are invited for appointment as Lecturer in the Department of Mechanical Engineering. Salary £550, rising by £25 every year to £650, and then, if the appointment is renewed, £700, with superannuation provision under the Federated Superannuation Scheme for Universities and family allowance. Further particulars may be obtained from the undersigned, with whom applications (four copies) should be lodged by December 7, 1946.

A. W. CHAPMAN,
Registrar.

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Birmingham Central Technical College
Suffolk Street, 1

Department of Chemistry

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E. L. RUSSELL,
Chief Education Officer.

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London, E.C.1

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ESSEX EDUCATION COMMITTEE

South-East Essex Technical College
Department of Chemistry and Biology

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Duties, which will begin on January 1, or as soon after as possible, will involve instruction of classes in chemistry up to general and special degree standard.

The salary will be in accordance with the Burnham Technical Scale, plus London allowance.

Forms of application and further particulars are to be obtained by sending a stamped addressed envelope to the Clerk to the Governors at the College, Longbridge Road, Dagenham, Essex, and should be returned to him not later than December 2, 1946.

B. E. LAWRENCE,
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JOSEPH GRIFFITH,
Superintendent-Secretary.

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UNIVERSITY OF BIRMINGHAM

Department of Zoology

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Further particulars may be obtained from the undersigned, to whom applications should be submitted not later than December 7.

C. G. BURTON,
Secretary.

The University,
Edmund Street, Birmingham, 3.

**ROYAL VETERINARY COLLEGE
AND HOSPITAL**

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The Oxford Delegacy for the Inspection and Examination of Schools proposes to appoint a full-time Secretary to succeed Mr. C. H. Wilkinson in May, 1947. He will receive a salary of £1,000 a year, rising to £1,200. Applications should be sent before December 20, 1946, to the Chairman, Oxford and Cambridge Schools Examination Board, 74, High Street, Oxford, from whom further particulars may be obtained.

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New Zealand

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Dunedin, New Zealand

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Dunedin, New Zealand

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STANLEY DUMBELL,
Registrar.

BEDFORD COLLEGE FOR WOMEN

(University of London)
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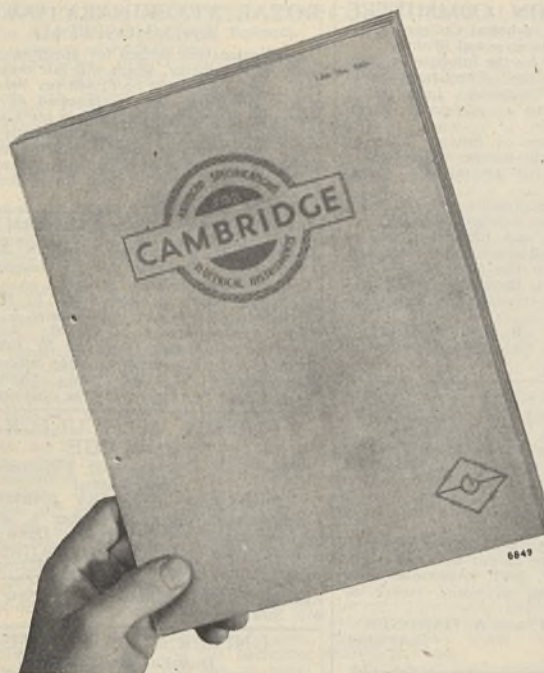
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UNIVERSITY OF LONDON

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(Continued on pages cixxxvi and clxxxvii)



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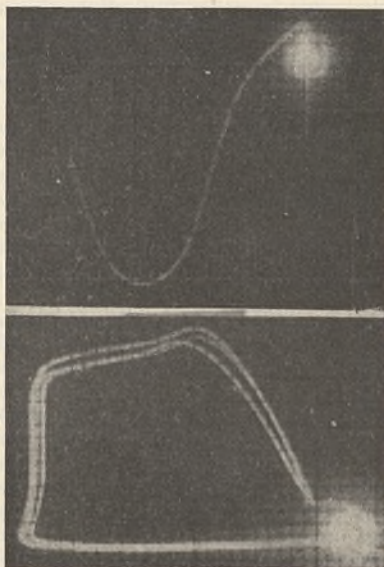


Fig. 1

Fig. 2

SWEEP-TIME, 1 MSEC.

cathode ray oscillograph, Type 175 A., using either the anterior or the posterior discharge to start the sweep of the cathode beam.

Fig. 1 shows a picture of the oscillograph screen when the anterior part provided the positive pulse necessary to discharge the sweep circuit. It is seen that there is a peak which has the polarity corresponding to the discharge of the posterior part, which was connected to the vertical plates.

This figure shows that the discharge occurs an instant before the pulse which initiated the sweep of the cathode beam. The results are confirmed by Fig. 2, in which the connexions were reversed. The anterior part was connected to the vertical plates and the posterior part to the circuit which discharges the sweep. (The connexion was made through an electronic tube so as to produce a necessary inversion of polarity. As is known, the sign of the electric pulse at this point is negative³.) It is apparent that the potential applied to the vertical plates presents a time-lag in relation to the one which initiates the sweep.

The experiments suggest that the small peaks begin at the posterior part of the organs. Very rough measurements indicated a pulse speed of approximately 1,600 metres a second.

It should be pointed out that we used a fish in which two small windows had been cut through the skin a week before, thus ensuring the insertion of the electrodes directly in the principal organ anteriorly, and in the bundle of Sacks posteriorly.

Further details will be published later.

C. CHAGAS
A. LEÃO
M. F. MOREIRA

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Department of Physics,
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Brazil.

Oct. 14.

M. SOUZA SANTOS

Skim Cheese as an Indispensable Food for the Poor in Egypt

SKIM cheese is prepared in Egypt from milk skimmed by hand. It may either be eaten fresh or left to ripen in baked earthenware pots. To it may be added whey, skim or whole milk, etc. Even under careful supervision, preparations made by the same process showed wide variation in composition.

Values are presented for the protein content of skim cheese from various localities. The amount varies from 6.69 to 21.94 per cent and averages 16.63 per cent. This rather wide variation demonstrates the influence of the methods employed in preparing and processing this foodstuff on its protein value. Our values agree favourably with the amount of protein present in cottage cheese (soft unripened cheese resembling our skim cheese) where it varies from 12.70 to 21.00 per cent according to Right. This finding supports the idea that most varieties of skim cheese examined must find their most useful place as protein supplements in human diet.

The most variable constituents are fat and water. Fat was found to be practically absent in some samples but high in others, reaching 19.51 gm. per cent. The high figures are found only in the stored cheese due to the materials added (for example, whole milk). The average amount of fat is 4.16 per cent. It is thus richer than cottage cheese where the fat content does not exceed 1.90 per cent. The variation in the water content is quite conspicuous. It ranges from 52.30 to 84.85 per cent, and so differs from cottage cheese where the range is between 71.40 and 79.90 per cent.

The calcium content varies from 0.130 to 0.817 gm. per cent with an average of 0.292 gm. per cent. This shows that skim cheese is an excellent source of calcium in the diet especially if compared with the amount of calcium present in milk, eggs, wheat or white bread. Phosphorus varies from 0.110 to 0.573 gm. per cent with an average of 0.282 gm. per cent. Skim cheese is also a good source of phosphorus compared with milk, eggs, wheat or white bread. The diet of the poor in Egypt contains a lot of green vegetables such as watercress, radishes, chicory, etc., which are also very rich in phosphorus.

As regards vitamins, skim cheese contains an amount of vitamin B₁ too small to be considered. Nicotinic acid presents itself in the range of 0.19–1.89 mgm. per cent with an average of 0.70 mgm. per cent. The amount of vitamin A averages 17 I.U. per 100 gm., although it may reach 1,463 units in some samples rich in fat.

The digestibility of proteins, fats, calcium and phosphorus of skim cheese was found to be 96, 87, 67 and 74 per cent compared with that of the ordinary soft non-skim cheese which is 96, 97, 60 and 89 per cent respectively. The amount utilized of these ingredients in skim cheese is shown to be 27, 33, 41 and 8 per cent compared with that in non-skim type, which is 53, 89, 43 and 46 per cent respectively. Thus increase of fat content improves the utilization of protein, fat and phosphorus, but has no effect on calcium utilization.

Skim cheese is the cheapest kind of cheese; it is possible to buy for five millimes more than a pound of skim cheese containing 90 gm. of casein or even more.

Skim cheese can thus be regarded as an almost indispensable protective food for the poor in Egypt. Although it lacks some of the vitamins through

¹ Coates, C. W., Cox, R. T., and Granath, L. P., *Zoologica*, 22, Part 1 (April 5, 1937).

² Chagas, C., "Livro de Homenagem aos irmãos A. e M. Ozorio de Almeida" (Rio de Janeiro, 1939).

³ Chagas, C., and Pereira, L., *J. Cell. and Comp. Physiol.*, in the press.

partial removal of fat, it still retains the most highly nutritive protein (casein), a part of the vitamins, most of the calcium and phosphorus. It is, in fact, an excellent source of phosphorus and particularly of calcium. It has been observed in Egypt that in districts where skim cheese is frequently eaten no rickets occur.

M. M. TAHA EL-KATTB

Faculty of Agriculture,
Fouad I University,
Cairo.
Oct. 2.

Use of Growth-promoting Substances for Weed Control in Sports Turf

IN a recent article, Templeman¹ discusses the use of growth-promoting substances for selective weed control, referring particularly to agricultural operations with 2-methyl-4-chloro-phenoxyacetic acid ('Methoxone' or M.C.P.A.). He is concerned mainly with annual weeds, while the problems associated with control of well-established perennial weeds in a turf sward call for a somewhat different approach.

Starting only last autumn, we have carried out an extensive experimental programme to try out the most promising of the growth-promoting substances, namely, 'Methoxone' and '2:4.D' (2:4-dichloro-phenoxyacetic acid, D.C.P.A.), on closely mown swards containing the commoner turf weeds. Experiments conducted by us have followed a replicated random block technique. New experiments have been commenced at frequent intervals throughout the year, and different rates and methods of application have been tried. In addition, the effects of mowing and of different fertilizer treatments have been studied in conjunction with the two substances. A considerable number of simple large-scale co-operative trials conducted throughout Britain are providing ample confirmation of our experimental findings as regards 'Methoxone', but adequate supplies of '2:4.D' were not available in time for similar large-scale trials to be carried out with it this year. We hope to pursue this object next season.

Results have been most gratifying. Under suitable conditions of weather and growth, 'Methoxone' applied at the rate of 6 lb. per acre, as spray or powder, will give practically complete control of the more common weeds of turf including broad-leaved plantain (*Plantago major*), ribwort plantain (*P. lanceolata*), buck's-horn plantain or starweed (*P. coronopus*), self-heal (*Prunella vulgaris*), creeping buttercup (*Ranunculus repens*) and cat's-ear (*Hypochaeris radicata*). We have found control to be speedier and more efficient if application of 'Methoxone' is preceded by a dressing of nitrogenous fertilizer, such as sulphate of ammonia. This seems to increase the effect of 'Methoxone' on the weeds and at the same time masks the slight check caused to the growth of the sward. It also encourages the grass to 'fill in' after the weeds. Results with '2:4.D' are not dissimilar from those obtained with 'Methoxone', although it seems possible that rather lower rates per acre may prove adequate.

Typical results are shown in the accompanying table, which summarizes some of the results obtained in an experiment carried out on a local cricket ground in July. Effective control was measured six weeks after treatment, all plots in this case having

Treatment	Percentage area covered by 'main weeds'		Per cent control
	Before treatment	After treatment	
Control	25.8	26.2	—
6 lb. 'Methoxone' per acre as spray	25.8	2.6	89.9
6 lb. 'Methoxone' per acre as powder	33.5	5.6	83.3
6 lb. '2:4.D' per acre as spray	43.0	3.4	92.1
6 lb. '2:4.D' per acre as powder	35.2	0.7	98.0

received pre-treatment with nitro-chalk seven days in advance of the weed-killer application. The 'main weeds' were daisy (*Bellis perennis*), dandelion (*Taraxacum* sp.), clover (*Trifolium repens*), plantain (broad-leaved and ribwort) and self-heal.

Heavy rain falling shortly after application of either chemical is likely to nullify its effects. The experiments show some differences between the effects of 'Methoxone' and '2:4.D', such as, for example, in persistency and in effects on germination and growth of grass seeds.

A fuller account of this work will be published in the next issue of the *Journal of the Board of Greenkeeping Research* and elsewhere; to those responsible for the management of turf the introduction of 'Methoxone' and '2:4.D' would appear to open up an entirely new approach to the turf weed problem.

R. B. DAWSON
J. R. ESCRITT

Board of Greenkeeping Research,
St. Ives Research Station,
Bingley,
Yorkshire.

¹ *Agriculture*, 53, No. 3, 105 (1946).

Methods of Marking Reptiles for Identification after Recapture

WHEN studying, in the summer of 1939, a mid-Swedish population of the grass-snake, *Natrix natrix* (L.), we considered it necessary to work out some method of identifying each individual snake from year to year, making it possible to follow its changes in colour and size, etc., with increasing age, the appearance and subsidence of sicknesses, the healing of wounds, the sexual cycle, and movements within the territory inhabited by the population. The movements of individuals could not be studied in any other way; and the morphological changes with age were otherwise determinable merely as a result of statistical population studies, which could only be rough approximations, the individual variation in growth being far too great for it to be possible to distinguish the higher age-classes even with plentiful material.

Three methods, with some variations, were tried concurrently. Scissor cuts removing part of a sub-caudal shield were made in various combinations, permitting of the distinctive marking of a great number of individuals. This method was used some years ago by Blanchard and Finster¹ with some American snakes, among which was also one of the genus *Natrix* (*N. sipedon*). However, such marks do not seem to be quite permanent, the growth of the shield leaving after some years but slight trace of the incision. Thus it is necessary to recapture the

snake within a limited space of time and to mark it again if it is to be possible to follow it during a considerable period. Furthermore, the subcaudals of the new-born young are difficult to deal with, at least in the case of small species, as well as the ventrals (with which corresponding trials were made in our specimens). Their frequent skin changes also eliminate the scars rather soon. Being specially interested in young individuals, we decided not to proceed with this method.

The impossibility of marking new-born specimens is also a great obstacle to the use of numbered metal objects. Even with older individuals it is difficult to find any type of marking which is not obliterated by wear or by skin change and growth. At least for the small European species, this method is not practicable.

The third method had an initial advantage compared with the others, as it called for no incision in the snake. It was based on the fact that the black-and-white pattern which is found on the under-side of the grass-snakes has an infinite range of variation. Assuming that this pattern remains constant during the life of the specimen, we took photographs of a series of snakes showing a sequence of ventral shields of different patterns, after which the snakes were released. The result was quite satisfactory. On the recaptured specimens there was complete conformity with the earlier photographs as regards the distribution of black and white, the smallest details being still unchanged after a considerable increase in size—a system as sure as the finger-prints of the police. This method was a help to us in the study of many problems in the biology of *Natrix*, as we could follow the individual snake from its early days to its death, noting at varying intervals interesting changes in detail. At present, we have populations 'marked' in various parts of Sweden. A sequence of four to eight of the first twenty ventrals has been drawn for every specimen in our register, and the identification is furthermore confirmed by details noted for taxonomic purposes, such as the number of ventrals and subcaudals, variations in the scales of head and throat, and the type of design on the upper side.

The application of the method to other species than *Natrix natrix* has not yet met with any insurmountable difficulties. For many members of the same genus the ventrals have patterns similar to those of the grass-snake. As regards other groups, photographs of the back pattern can be used for *Coronella* and *Vipera* species, as we have found in populations studied by us; and most other snakes are likely to have some constant pattern which can be employed for the same purpose.

A point of interest was the discovery that good results could be obtained in just the same way with lizards; we have worked with *Lacerta vivipara* (photographs of back pattern) and *Anguis fragilis* (photographs of throat).

Recent experiments made by Edelstam with this method on amphibians have already given positive results. Possibly the characteristic dark-and-light patterns occurring in many groups of Anura and Urodela will prove as serviceable in this respect as that of the reptiles.

DIEGO CARLSTRÖM
CARL EDELSTAM

Karlav. 9,
Stockholm.
Oct. 20.

¹ *Ecology*, 14 (1933).

Occlusion of the Oviduct in the Cloaca after Spawning in some Salientia

It has been stated that the Müllerian ducts of frogs and toads open into the cloaca comparatively late in life, generally when the female becomes sexually mature^{1,2}. It is not recorded whether they remain open or close up after spawning¹⁻⁶. In the course of investigations on the urinogenital organs of Salientia, I have observed an occlusion of the oviducal (uterine) aperture in the cloaca which deserves notice.

A 38.0-mm. breeding female marsupial frog, *Gastrotheca boliviana griswoldi* Shreve, carrying eight developing eggs in its dorsal integumentary pouch, was dissected and found to possess enlarged oviducts and spent ovaries. In their course from the posterior level of the kidneys the oviducts are dilated into uteri which run in apposition to each other so closely that only a partition wall separates the two. The Wolffian ducts run dorsally and are closely apposed on the outer walls of the uteri. The posterior region of the gut and the urinogenital ducts were carefully dissected out, and serial transverse sections at 10 μ were made. The sections show that the inner uterine wall has longitudinal folds with a glandular epithelial lining, and that the two uteri become confluent posteriorly through the disappearance of the partition wall. Thus a common uterus is formed which runs for about a millimetre (90 sections) before terminating in the cloacal wall. As the common uterus and the overlying Wolffian ducts are incorporated within the cloacal wall, there is formed a urinogenital papilla which bulges into the cloacal lumen. On tracing the uterus I found, contrary to expectation, that there was a complete occlusion of its aperture into the cloaca, the bulging ventral wall of the papilla being covered by a single layer of cells. Although very careful examination of the series of sections revealed no sign of an opening from the uterus, the Wolffian ducts could be seen opening separately into the cloaca posterior to the occluded uterine opening.

The breeding habit of *Gastrotheca*, unique among Amphibia, is well known², and as the specimen examined was a breeding female, the complete occlusion suggests that the uterine aperture may close up after spawning.

I have also observed a similar occlusion in two adult Leptodactylid frogs, namely, *Leptodactylus pentadactylus* (Laurenti) and *Eleutherodactylus nubicola* Dunn, measuring 130.0 mm. and 35.0 mm. respectively. Both appeared to have spent ovaries and well-developed oviducts. An examination of the serial sections showed a complete occlusion of the uterine openings which appeared to have occurred after spawning. It should especially be noted that in *E. nubicola* the two uteri become confluent as soon as they touch each other ventrally to the posterior level of the kidneys, and also that the two Wolffian ducts unite with each other posteriorly. The common Wolffian duct thus formed runs for about a millimetre and a half before opening into the cloaca posterior to the occluded opening of the common uterus. In *L. pentadactylus*, however, both the uteri and the Wolffian ducts run separately throughout their course as in ranid frogs.

It would appear from the above observations that the Müllerian ducts open into the cloaca with the onset of the breeding phase and close up some time after spawning. The exact time and method of closure cannot, however, be indicated from the material at hand.

Attention may be directed here to a recent statement by Parker⁷, referring to the abdominal pore in the yellow perch (*Perca flavescens*), that "All the evidence so far obtained, however, leads to the conviction that no such pore exists in the adult fish and that the opening through which the eggs are discharged represents a true, although temporary, rupture. . . . After oviposition the opening closes rapidly and in time disappears." This, by analogy, supports my observations, and raises the fundamental question whether there may not be a closing of the oviducal (uterine) aperture into the cloaca after oviposition in all lower vertebrates. It is hoped that the publication of this note may arouse interest in the study of this problem.

I take this opportunity of thanking Mr. A. Love-ridge (Museum of Comparative Zoology, Harvard University), Dr. C. M. Boggert (American Museum of Natural History) and Dr. W. G. Lynn (Catholic University of America, Washington), who kindly sent me the specimens upon which my observations are based. It is also my pleasant duty to thank Prof. J. Ritchie for giving me facilities to work in his laboratory and for reading this note.

J. L. BHADURI

Zoology Department,
University of Edinburgh.
Oct. 5.

¹ Felix, W., and Bühler, A., *Hertwig's Handb. vergl. exp. Entw. Wirbelt.*, 3, 750 (1906).

² Noble, G. K., *Ann. N.Y. Acad. Sci.*, 30, 31 (1927). "The Biology of the Amphibia" (1931).

³ Spengel, S. W., *Arb. zool.-zoot. Inst. Würzburg*, 3, 7 (1876).

⁴ Gadow, H., "Cambridge Nat. Hist.", 8, 48 (1901).

⁵ van den Broek, A. J. P., *Handb. vergl. Anat. Wirbelt.*, 6, 64 (1933)

⁶ Gallien, L., *Bull. Biol.*, 78, 257 (1944).

⁷ Parker, J. B., *Copeia*, 4, 223 (1942).

Micronucleus of *Epistylis*

WHILE studying the cytology of species of *Epistylis*, it was noticed that the nuclear apparatus of this ciliate presented certain interesting features. The macronucleus of *Epistylis* is a large and band-shaped body, staining deeply with all nuclear stains, and especially with Feulgen. The micronucleus is a small spherical structure situated in the neighbourhood of the macronucleus. The staining reactions of the micronucleus in two species of *Epistylis* show a significant difference. In *Epistylis articulata* From., the micronucleus is easily discernible as a deeply staining body. In *E. plicatilis* Ehrbg., on the other hand, the micronucleus gives a thoroughly negative reaction to Feulgen. Sometimes there are one or two minute granules which stain pink, but the rest of the nucleus is unstained. The difference is all the more striking because in the same mass culture both species were present, and they were treated together in the matter of fixation and staining.

Since Feulgen is the most specific nuclear reaction known, and is selective to one type of nucleic acid, the desoxyribose or thymonucleic acid, it appears that, so far as staining reactions are an indication, the desoxyribose nucleic acid content of the micronucleus of these two species is different. This is very interesting, for we believe that this is the first time the micronucleus of two species of the same genus of a ciliate is seen to exhibit a differential nucleic acid content. Whether on the analogy of the metazoan nucleus this difference between the nucleic acid of the micronuclei of the two species of *Epistylis* is

correlated with a difference in protein content is not known.

It has long been known that the micronucleus of ciliates divides mitotically while the macronucleus is amitotic. If this means the formation of the chromosomes in one and not in the other, Painter's¹ recent observations on *Tetrahymena galeii*, where he reports the formation of "normally coiled and otherwise orthodox chromosomes" during the division of the macronucleus of this ciliate, are full of interest. This is in accordance with the staining reactions. The macronucleus gives a brilliant stain with Feulgen and should contain a large amount of desoxyribose nucleic acid, which we know is associated with the chromosomes. If the macronucleus does not form the chromosomes, then the association of large quantities of desoxyribose nucleic acid with it would need an explanation. In any event, the occurrence of desoxyribose nucleic acid in the macronucleus and its almost entire absence in the micronucleus of *E. plicatilis* is very interesting.

B. R. SESHACHAR
K. V. SRINATH

University of Mysore,
Central College, Bangalore.
Oct. 3.

¹ Painter, T. S., *Trans. Conn. Acad. Arts and Sci.*, 38, 443 (1945).

Man's Reaction to Mosquito Bites

DR. MELLANBY'S communication in *Nature* of October 19 describes an investigation in progress on the reactions of different individuals to mosquito bites. These investigations could provide an opportunity to test another matter which might lead to results of far-reaching importance.

Biting insects have their preferences. Some will only attack one host species. Thus there are fleas, bird-lice, ticks, etc., which feed exclusively on one bird or animal species. The yellow fever mosquito with which Dr. Mellanby is experimenting will bite, I believe, only a few birds and animals. Coming to man, it is commonly asserted that biting insects have a marked preference for some individuals, and I know people who believe that they have never been bitten by any insect. Is this true, or is it merely that they have reached Stage IV in Dr. Mellanby's reaction list and neither feel the bites nor suffer any after-effects? Tests could be carried out on those who make such claims and, if there is any marked preference shown by insects, I suggest that it might be a matter of the utmost importance to discover the reason. If, to simplify the problem, it were found to be due to the presence of minute quantities of some substance in the blood, the possibility might arise of injecting ourselves with a substance that would make us unattractive to biting insects.

In measuring the importance of this line of inquiry, we can bear in mind three things: (1) that in the world as a whole more premature deaths are probably brought about annually by the direct and indirect results of insect bites than from any other cause; (2) that the bites of many insects, such as midges, are a matter of extreme discomfort even though they may cause no ill-effect; and (3) that vast sums of money are expended annually both in attempts to destroy biting insects and in connexion with the illness they cause.

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THE question of the relative attractiveness to biting insects of different individuals is an interesting one. It was considered possible that some individuals would be relatively or completely unattractive to mosquitoes, and some experiments were initiated by the Army Malaria Research Unit during the War. I was responsible for carrying out the entomological side of this investigation. Working with *Aedes aegypti* and *Anopheles maculipennis atroparvus*, we never found any person who was completely unattractive; in fact, when hungry mosquitoes were given the opportunity of biting, they appeared to feed on every individual with equal readiness. It should be noted that in these experiments no alternative source of food was available.

It is more difficult to carry out satisfactory experiments in which mosquitoes are given a choice of individuals on which to feed. A considerable number of experiments was, however, carried out with volunteers in cages exposed to *Aedes aegypti*. I was unable to discover any consistent preference for any particular person or any consistent avoidance of another.

Dr. Bristowe suggests that the apparent differences in the attraction of individuals may be due to their giving different reactions to the bites. I think that is the main explanation. The delayed reaction to bites is very much more troublesome than the immediate, and thus those in Stages I and II are much more conscious of a mosquito nuisance than those in Stages III and IV. Thus, if two individuals are exposed to mosquitoes on several consecutive days, the one who gives the delayed reaction may imagine that every bite which is itching on a particular occasion has been recently inflicted, though they are the result of attacks on the preceding three or four days.

I believe that eventually we shall find that there is some individual difference in the attractiveness of individuals to mosquitoes and other biting insects, but that it will not be an absolute one or sufficiently important to suggest a method of control. So far those cases which have been carefully investigated tend to minimize the importance of this factor.

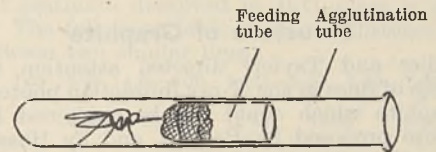
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A Technique for Feeding Adult Mosquitoes

ADULT mosquitoes of both sexes can be persuaded to take a considerable variety of foodstuffs, including fruit juices, milk, sugar solutions and various blood preparations. Some interesting lines of inquiry are suggested by the inability of such species as *Culex fatigans* to produce eggs on any diet other than whole blood taken by normal biting, while other species, such as *Aedes aegypti*, can produce viable eggs on defibrinated or citrated blood. In the course of a number of experiments at Yaba with various blood preparations, only one *Culex fatigans* produced any eggs. These were very few in number and were never laid. They were discovered only on post-mortem examination. The mosquito had received one meal of citrated guinea pig blood followed by several meals of glucose. It has been found repeatedly that the same species will produce many more eggs on a meal of avian blood than on one of mammalian blood.

Feeding techniques based on the use of a pipette, such as those of Hertig¹, Karibov², Macgregor³, Kadletz and Kusmina⁴ and Vainshtein⁵, are tedious and require considerable manipulative skill. Nor does it appear that blood taken in this way undergoes the same process of digestion as when it is taken in the normal manner. Methods in which the food is exposed on an open surface of wool or gauze, such as those of Russell⁶, and Roy and Ghosh⁷, or taken through a membrane (Totze⁸, Yeoli⁹), are excellent for feeding a number of mosquitoes simultaneously, but do not allow of the individual control required by some experiments. The technique described below has the advantage of simplicity and has been found particularly useful in transmission work with virulent virus, since each mosquito is kept under constant observation and the risk of escape is minimized. At Yaba it has been found possible to infect male *Aedes aegypti* with neurotropic yellow fever virus administered as a suspension in defibrinated guinea pig blood, and to recover considerable quantities of virus after a fortnight's incubation.



The mosquitoes to be fed are allowed to emerge from the pupa in ordinary serum agglutination tubes closed by a plug of cotton wool or gauze through which the water is poured off after emergence. The food is administered on the end of a half-inch feeding tube cut from glass tubing of external diameter such that it slides easily into the agglutination tube. A suitable surface on which to place the food is provided by pushing a small circle of linen gauze down the inside of the feeding tube and allowing it to project in the form of a cap. The food is dropped on this cap from a pipette and the feeding tube is then pushed down the agglutination tube towards the mosquito. The success of the method appears to depend mainly on choosing a suitable interval between emergence and feeding. The optimum time may be expected to vary with temperature. Approximate times which have been found suitable in West Africa are as follows: *Culex fatigans*, 72 hours; *Aedes aegypti*, 60 hours; *Aedes luteocephalus*, 48 hours.

Culex fatigans has proved particularly suitable for experimental work, as it is prolific, feeds well, and is of such a size that its movements in the tube are slowed down, although it is not unduly cramped.

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Sept. 30.

¹ Hertig, A. T., and Hertig, M., *Science*, **65**, 328 (1927).

² Karibov, N., *Nachr. Trop. Med.*, **1**, 73 (1928).

³ Macgregor, M. E., *Trans. Roy. Soc. Trop. Med. Hyg.*, **23**, 329 (1930).

⁴ Kadletz, N. A., and Kusmina, L. A., *Arch. Schiffs-u. Tropenhyg.*, **33**, 335 (1929).

⁵ Vainshtein, N. B., *Med. Parasitol.*, **5**, 288 (1936).

⁶ Russell, P. F., *Amer. J. Trop. Med.*, **11**, 355 (1931).

⁷ Roy, D. N., and Ghosh, S. M., *J. Malar. Inst. of India*, **3**, 253 (1940).

⁸ Totze, R., *Zbl. Bakt.*, **132**, 382 (1934).

⁹ Yeoli, M., *Riv. Malarial.*, **17**, 62 (1938).

Browsing of *Patella*

DURING a recent investigation of *Gigartina stellata* which has been carried out at Millport, Isle of Cumbrae, I have been struck with the relationship between the limpet (*Patella vulgata*) and the seaweed, and have observed effects very comparable with those described by Mr. N. S. Jones¹. This work is being described in more detail elsewhere, and will, I think, confirm the observations of Jones, Orton, Eslich and others that *Patella* is able to browse on young algal growths, and, by the 'glades' that it forms in an algal community, may considerably lessen the algal covering on that part of the shore.

As Mr. Jones points out, this is a point of fore-shore ecology that may be worthy of more attention than it has hitherto received.

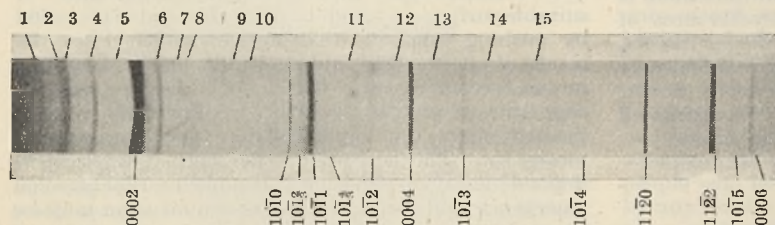
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Oct. 31.

¹ *Nature*, 158, 557 (1946).

Structure of Graphite

Laidler and Taylor¹ directed attention to the presence of lines in the X-ray diffraction photographs of graphite which could not be explained by the structure proposed by Bernal², and by Hassel and Mark³: these lines are given by graphites from many different sources, natural and artificial. Similar extra lines on electron diffraction photographs of graphite had been observed by Finch and Wilman⁴. Edwards and Lipson⁵ thought that they may be caused by anomalies in the structure of graphite similar to those found in cobalt⁶, but occurring at regular intervals, and proposed a new structure which would



account for these extra lines⁷. In this, the flat, honeycomb net planes are stacked parallel to each other, but instead of having the *abab* sequence of the Bernal structure, they have an *abcabc* sequence: this gives a unit cell with a *c*-axis one and a half times the usual one. From intensity data they calculated that this new structure represented about 14 per cent of the graphite, the remainder being made up of 80 per cent of the ordinary structure and 6 per cent of a disordered structure. It is interesting to note that this new structure was the first structure suggested for graphite, by Debye and Scherrer⁸ in 1917.

The structure of graphite, however, does not yet appear to be fully elucidated. Powder photographs of graphite have been obtained containing a number of lines which cannot be explained on either of the two structures mentioned. These lines are fainter than those observed by Taylor and Laidler, but their occurrence is as general; all the natural and artificial graphites so far examined give these lines. The illustration shows a typical photograph, obtained by doubling the normal exposure time; the background

scatter was reduced by passing pure, dry hydrogen through the powder camera and placing a thin sheet of aluminium foil between the specimen and the photographic film. The sample from which the photograph was obtained had been purified as follows. It was extracted exhaustively with hydrochloric acid followed by hydrofluoric acid (final ash content 0.07 per cent) and then heated *in vacuo* to 2,300° C. and maintained at that temperature for half an hour. An extruded specimen 0.5 mm. diameter was photographed in a 19-cm. diameter powder camera using cobalt *K α* radiation. A list of $\sin^2 \theta$ values for the extra lines on this film is given below. The lines were much weaker than the normal graphite lines, so that no attempt has been made to assess their relative intensities. Their positions were measured with a measuring instrument⁹ specially designed for the purpose. A number of very pure artificial graphites (ash content < 0.05 per cent) have also been examined and all show these extra lines.

Line No.	θ	$\sin^2 \theta$	Line No.	θ	$\sin^2 \theta$
*1	9.38	0.0266	9	21.32	0.1322
*2	10.66	0.0342	*10	22.44	0.1456
*3	10.98	0.0363	11	28.41	0.2263
*4	12.68	0.0482	12	31.39	0.2713
*5	13.96	0.0582	13	33.71	0.3080
*6	16.79	0.0834	14	36.82	0.3591
7	17.81	0.0935	15	39.72	0.4082
8	18.40	0.0996	16	67.30	0.8511

* Double lines: mean values given.

The lines marked with an asterisk are double and each consists of two well-defined separate lines. In every case the angular separation is 0.20°, which makes it unlikely that they are separate reflexions. Furthermore, they were examined on a photograph taken in a camera of different diameter (9 cm.): in this case, taken as separate lines, their diffraction angles differed slightly, but definitely, from those of the same lines on the film from a 19-cm. diameter camera; taken as pairs, the mean values were exactly the same. The 0002, 0004 and 0006 lines of the ordinary graphite structure were also double, and this has been explained by Nelson and Riley¹⁰ as being due to preferred orientation of crystals in the specimen. This seems to suggest that the extra lines are due to a structure closely related to the ordinary structure and that the extra double lines may be 000 l reflexions. The layer-lattice structure of graphite makes it susceptible to modification by alteration of the sequence of layers. A preliminary examination of boron nitride, which has a similar layer-lattice structure, indicates that its spectrum also contains extra lines.

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¹ Laidler, D. S., and Taylor, A., *Nature*, 146, 130 (1940).

² Bernal, J. D., *Proc. Roy. Soc. A*, 108, 749 (1924).

³ Hassel, O., and Mark, H., *Z. Phys.*, 25, 317 (1924).

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⁵ Edwards, O. S., and Lipson, H., *Proc. Roy. Soc. A*, 150, 268 (1942).

⁶ Edwards, O. S., Lipson, H., and Wilson, A. J. C., *Nature*, 148, 165 (1941).

⁷ Lipson, H., and Stokes, A. R., *Proc. Roy. Soc. A*, 181, 101 (1942).

⁸ Debye, P., and Scherrer, P., *Phys. Z.*, 18, 291 (1917).

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¹⁰ Nelson, J. B., and Riley, D. P., *Phil. Mag.*, 38, 711 (1945).

Single Scattering of Fast β -Particles by Protons

WE have recently taken some eight hundred pairs of photographs corresponding to about 124 metres of track of β -particles, of energies from 0.5 to 1.1 mV., in a mixture of 80 per cent hydrogen and 20 per cent oxygen, contained in an expansion chamber. Assuming that the scattering of the β -particles in oxygen is similar to that of the adjacent element nitrogen, for which results have already been obtained¹, the elastic scattering of these β -particles through angles greater than 20° by protons is found to be in agreement with Mott's theory. The theory predicted that about one such deflexion was to be expected; actually two cases were observed. The statistical fluctuations were therefore large, but it may be inferred that there is no serious discrepancy between existing theory and experiment for the collisions of protons and electrons of this energy.

As in the previous work with nitrogen, no examples of inelastic collision of electrons and protons were observed.

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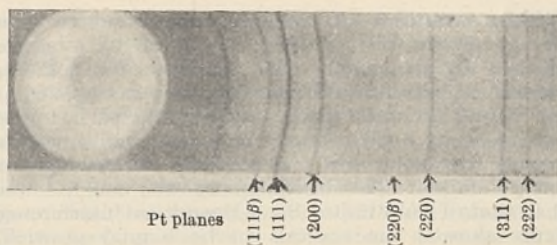
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X-Ray Study of Noble Metals Dispersed in Borax- and B_2O_3 -Glasses

IN a previous communication¹, it was shown by us that alkali halides such as lithium, sodium, potassium, rubidium and caesium chloride dissolved in fused boric oxide giving a homogeneous glass. X-ray examination of these glasses reveals sharp diffraction lines due to the dissolved alkali halides together with a few foreign lines which cannot be identified with any known borates of the metals. These foreign lines are largely present in glasses containing chlorides of alkali metals of low atomic numbers, but are absent with rubidium and caesium halides. It was found later that these foreign lines are due to a variety of anhydrous crystalline B_2O_3 , first studied by Cole and Taylor², in the case of boric oxide glasses, and to anhydrous $Na_2B_4O_7$ in the case of borax glasses.

The manner in which the alkali halide lattice exists within the non-repeating meshwork of boric oxide and borax glasses requires elucidation. Accepting Warren and Zachariasen's views about the structure of these glasses, one would be led to suggest that a new lattice is formed within the hollows of the cages formed by the B—O—B triangular bondage. But in such a case the electrostatic forces between the ions should be diminished, as also probably the short-distance repulsive forces, on account of the shielding action produced by a medium of higher dielectric constant necessitating an enlargement of the lattice. Preliminary experiments by Majumdar and Palit³ seemed to point to such a conclusion, but later work has shown that the spacings are almost unaltered in the glass.

An interesting case has been found with gold and platinum dispersed in boric oxide and borax glasses. The samples were prepared by first evaporating solutions of auric and platinum chlorides separately in a platinum crucible and then igniting, whereby the noble metals were obtained in a finely divided state. The reduced metals were then heated with specially



purified anhydrous B_2O_3 and $Na_2B_4O_7$, respectively at 800° – $1,000^\circ$ C., until thoroughly homogeneous (slightly coloured) masses were obtained. The crucible was then chilled and the solid extracted. Each piece of glass was examined under the polarization microscope for optical isotropy. The glass was then powdered, inserted in a capillary tube, and a Debye-Scherrer photograph taken with a circular camera (radius 3.90 cm.) and a Hadding tube with copper anti-cathode. The exposure varied from 8 to 10 hours. Photographs were also taken of pure gold and platinum wires and the prints compared. A typical print of platinum dissolved in B_2O_3 -glass is reproduced. The following table gives the distance x in cm. between two similar lines:

x ..	3.35	3.65	4.0	4.70	5.225	5.50	6.10	7.95	8.95
Nature	w	s	r.w	m	s	w	s	w	s
x ..	9.55	10.80	11.40	15.80	16.50				
Nature	w	s	w	s	s				

w = weak, r.w = rather weak, s = strong, m = moderate.

By trial and error method, the constant for $K\alpha$ (1.539 A.) is found to be 0.1954, and for $K\beta$ (1.389 A.) 0.1756. Hence the spacing a_0 for platinum dissolved in glass works out as follows:

$$\text{for } K\alpha, a_0 = \frac{1.539 \times 10^{-8}}{2 \times 0.1954} = 3.938 \text{ A.}$$

$$\text{and for } K\beta, a_0 = \frac{1.389 \times 10^{-8}}{2 \times 0.1756} = 3.950 \text{ A.}$$

the mean value, 3.944 A., being in good agreement with the standard value for platinum, namely, 3.910 A.

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¹ *Nature*, 156, 423 (1945).

² *J. Amer. Chem. Soc.*, 56, 1648 (1934).

³ *J. Indian Chem. Soc.*, 19, 461 (1942).

Cerium Tungstate as a Semi-Conductor

BOTH Zambonini¹ and Beintema² claim to have prepared tetragonal bipyramidal crystals of cerium tungstate, $Ce_2(WO_4)_3$, by fusing a precipitate, using sodium chloride as a flux. Subsequent work by Sillen and Sundvall³ showed that the compound was actually $NaCe(WO_4)_2$ of scheelite-type structure. Tammann⁴ has also described a cerium tungstate, but the only observations made were on the change with temperature of electrical resistance of powdered compacts. The resistance of a pellet 1 mm. thick and 14 mm. diameter was given as 40,000 Ω at 600° C. and 1,700 Ω at 800° C.

In an investigation which required the use of fired mixtures of cerium oxide (CeO_2) and tungstic oxide

(WO_3), a number of samples were found to give X-ray powder photographs suggestive of a single phase. In particular, the mixture $2\text{CeO}_2 \cdot 3\text{WO}_3$ (which can be expressed approximately as $\text{Ce}_2(\text{WO}_4)_3$) was found by microscopic examination to be quite homogeneous, consisting of small clear, round, yellow crystal fragments with no evidence of cleavage or natural faces. The birefringence was much lower than that of wolframite. Since the optical interference figure showed the crystals to be biaxial positive, implying either orthorhombic, monoclinic or triclinic symmetry, indexing of the X-ray powder diffraction pattern was difficult and examination of suitable single crystals was necessary. These were obtained, up to 1.5 mm. in diameter, by cooling the fused mixture of oxides very slowly in a platinum boat, to about 20° below the melting point ($1,060^\circ\text{C.} \pm 10^\circ\text{C.}$).

Oscillation photographs about the three crystallographic axes were taken using copper radiation. Laue photographs showed that the symmetry was monoclinic. The following unit cell dimensions were obtained: $a = 11.49 \pm 0.04$ kX.; $b = 11.70 \pm 0.04$ kX.; $c = 7.81 \pm 0.03$ kX.; $\beta = 109.8^\circ \pm 0.5^\circ$.

The presence of hkl spectra only when $k + l$ was even, the presence of hol spectra only when both h and l were even, and also the presence of oko spectra only when k was even, established the space group as either $C_{2h}^6 - A_2/a$ or $C_4^2 - Aa$, depending on the crystal class. Measurements of three well-developed crystals using a single-circle goniometer showed the habit to be pyramidal. The most prominent forms observed, although not always completely on the same crystal, were $\{111\}$ and $\{11\bar{1}\}$ followed by $\{100\}$ and $\{211\}$. The morphological evidence and the absence of a discernible pyroelectric effect (using the liquid air method of Wooster⁶) point to the crystal class $2/m$. The space-group, therefore, is probably $C_{2h}^6 - A_2/a$.

The chemical analysis of a second batch of the tungstate, prepared in the same way as the single crystals, was found to be as follows:

Constituent	Expressed as	% Found	Theoretical % in $2\text{CeO}_2 \cdot 3\text{WO}_3$
Tungstic oxide	WO_3	66.4	66.9
Rare earth oxides	CeO_2	33.5	33.1
Ferric oxide	Fe_2O_3	0.17	—
Alumina (by diff.)	Al_2O_3	1.52	—
Alkalis	Na_2O	0.13	—
Total		101.72	100.0

Electrical resistance measurements made with a pressed pellet (14 mm. diameter \times 5 mm. thick) which was pre-sintered at 600°C. showed no simple conductivity temperature relationship below $1,000^\circ\text{C.}$, but above this temperature the conductivity obeyed the relation $\sigma = A \exp -B/kT$ with $B = 14.6$ electron volts, the resistance being less than 5 ohms just below the melting point. The resistance was lowered in oxygen, a characteristic of an electron-defect lattice⁶.

The specific gravity of the powder ground to pass a 350-mesh sieve was found to be 6.65, $20/4^\circ\text{C.}$ The number of molecules of $2\text{CeO}_2 \cdot 3\text{WO}_3$ in the unit cell was calculated to be 3.83 (≈ 4). The departure from a whole number may be due either to slight inaccuracies in the determination of the unit cell dimensions or to the presence of sealed pores in the crystals.

The crystals were found to have a hardness between 3 and 4 on Moh's scale. Unlike scheelite, they do not fluoresce with X-rays. When heated in air or in an evacuated silica tube (the material is inert to silica)

they show a reversible colour change, from orange at 500°C. to deep red at 900°C. This reversible colour change is shown by at least two semi-conductors, hexagonal ZnO and monoclinic PbCrO_4 , both of the electron-excess type⁶.

A list of the interplanar spacings and intensities of the powder pattern has been prepared which is being submitted for inclusion in the next supplement of the A.S.T.M. X-ray Diffraction Data Cards.

Thanks are due to Mr. A. M. Adams, who assisted us in the experimental work.

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¹ Zambonini, J. F., *R. R. Accad. dei Lincei*, **12**, 519 (1913).

² Beintema, J., *Proc. Konin. Akad. Wetenschappen, Amsterdam*, **38**, 1 (1935).

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⁴ Tammann, G., *Z. anorg. Chemie*, **149**, 35 (1928).

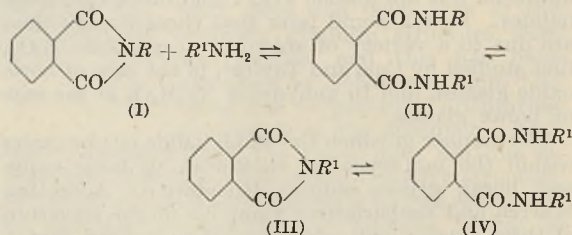
⁵ Wooster, W. A., "Crystal Physics" (Camb. Univ. Press, 1938), 225.

⁶ Seitz, F., *J. App. Phys.*, **13**, 553 (1945).

The Reaction Between N-Substituted Phthalimides and Primary Amines

We have shown that treatment of phthalimide with a primary aliphatic amine such as methylamine gives NN'-dimethylphthalamide in high yield¹. The controlling step in the reaction sequence was found to be the remarkable ease of conversion of N-methylphthalimide into N-methylphthalamide, which occurs rapidly and quantitatively on shaking with water at room temperature. In view of the recent communication of H. J. Barber and W. R. Wragg², we now record some observations made in a continuation of our previous work.

When an N-substituted phthalimide (I) reacts with a primary amine, the reaction can be expressed as follows:



The variation in the nature of the reaction products is illustrated by the following examples. Treatment of N- β -aminoethylphthalimide (I) with benzylamine yields NN'-dibenzylphthalamide (type IV). Treatment of N- β -acetylaminoethylphthalimide with benzylamine gives N- β -acetylaminoethyl-N'-benzylphthalamide (type II); and treatment of N-methylphthalimide with ethylene diamine yields N- β -aminoethylphthalamide (type III). A previous example of the latter type of reaction has been described by Ristenpart³, who converted N- β -bromoethylphthalimide into N-methylphthalamide by treatment with methylamine.

The reaction sequence extends and includes our original observations, and, in agreement with Barber and Wragg, it gives a ready explanation of the isolation by Mosher⁴ of 8(γ -phthalimido-propylamino)-6-methoxyquinoline (type III) from the product of the reaction between N- γ -bromopropylphthalimide (I)

and the base R36 (8- γ -aminopropylamino-6-methoxyquinoline) employed in the preparation of the antimalarial substance R63.

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¹ Spring and Woods, *J. Chem. Soc.*, 625 (1945).

² *Nature*, 158, 514 (1946).

³ *Ber.*, 29, 2530 (1896).

⁴ *J. Amer. Chem. Soc.*, 68, 1565 (1946).

Hypochlorite Sterilization of Metal Surfaces Infected with Bacteria Suspended in Milk

It was first shown by Holwerda¹, and later confirmed by Levine and his co-workers^{2,3}, that *in solution* hypochlorite is germicidal by virtue of the undissociated hypochlorous acid.

Neave and Hoy⁴, working with metal surfaces artificially infected with a suspension of *Staph. aureus* in milk, found that the pH of hypochlorite solutions had little effect on the germicidal rate providing it did not exceed 11.

Using a technique essentially similar to that of Neave and Hoy and working with suspensions of *Staph. aureus*, thermophilic micrococci, and spores of *B. subtilis*, we found that the latter when dried in a milk film on a metal surface behaved identically as when suspended in solution, that is, solutions of low pH were more germicidal than at higher pH. Thus the percentage survivals of spores when in contact with a solution containing 50 p.p.m. available chlorine for 5 min. was 0.2, 2.5 and 80 at pH values of 7, 7.85 and 9 respectively.

The two vegetative organisms, on the other hand, behaved very differently, showing optimum 'kills' at pH values of 9.4, 9.8, 10.5 and 11 with concentrations of 25, 50, 100, 200 p.p.m. av. cl. respectively.

We suggest the following explanation, which is in keeping with the observed facts. The living protein-like cell wall of vegetative bacteria, as distinct from the refractile cell wall of spores, is able to adsorb

a protein film derived from the milk and perhaps organic matter of the medium. The hypochlorite solution before it can reach the vegetative cell has to react with this protein film, forming a 'chloroamine'. The survival curves obtained with the various solutions used appear to agree with a 'chloroamine' theory rather than hypochlorite. Charlton and Levine² have observed that monochloramine is more germicidal than hypochlorite at pH values above 9.5. Thus keeping the time of contact constant at 1 minute, an increase in concentration results in a higher concentration of 'chloroamine', which produces a higher 'kill', as illustrated by the graph. The contact time with the solution containing 25 p.p.m. av. cl. was 2 min. At 1 minute it would not have cut the curve for 50 p.p.m. av. cl. It also satisfactorily accounts for the greater survival of bacteria below pH values of approximately 9.5.

Metcalf⁵ has observed that at pH 14 monochloramine was completely hydrolysed. The increased survivals shown in the graph are probably due to hydrolysis of the 'chloroamine' due to increasing pH. It would thus appear that sterilization of surfaces by hypochlorites in the presence of milk and organic matter is largely due to the properties of a 'chloroamine' produced by the interaction of hypochlorite with some of the proteins. The importance of employing a detergent of not too alkaline a character in conjunction with hypochlorites, for example, in sterilization of dairy utensils and perhaps crockery, is obvious, and for efficient sterilization it would appear that the pH of the combined solution should not exceed 10-11.

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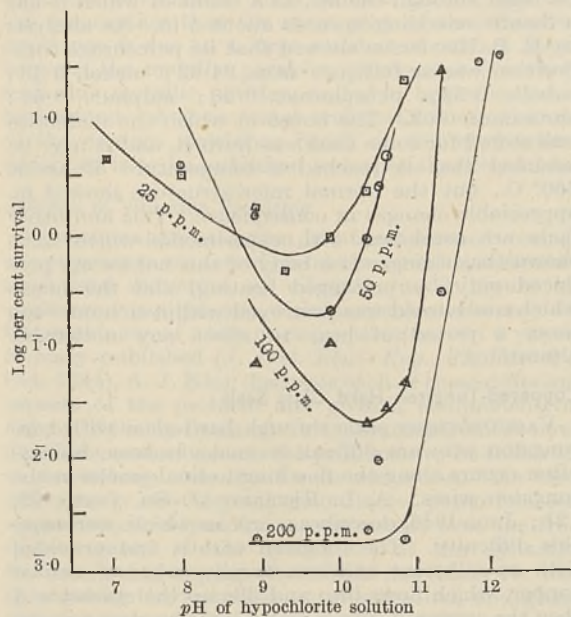
¹ Holwerda, *Meded. Dienst. der Volksgezondheid Ned. Indie*, 17, 251, Pt. 1 (1928).

² Charlton and Levine, *Iowa Eng. Exp. Stat. Bull.* 132 (1937).

³ Rudolf and Levine, " " " " " 150 (1941).

⁴ Neave and Hoy, *Proc. Soc. Agric. Bact.*, 37 (1941).

⁵ Metcalf, *J. Chem. Soc.*, 148 (1942).



A Simple Method of Demonstrating the Pressure of Sound

SOUND, in common with other forms of radiation, exerts a pressure on the surface on which it impinges. Measurements of this pressure have been made by Altberg and others by means of sensitive torsion balances. While measurements necessarily involve a certain degree of elaboration, a simple demonstration of sound pressure can be given without difficulty. A small hole is made in the base (or even in the side wall near the base) of a cylindrical resonator which is filled with smoke. On presenting an appropriate tuning fork, smoke issues from the hole in a thin but definite stream, thus demonstrating the steady pressure that sound exerts. The experiment provides an attractive demonstration of an important property of radiation.

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Oct. 18.

RESEARCH ITEMS

Auto-antibody Concept

A. TYLER (*Proc. U.S. Nat. Acad. Sci.*, 32, 195; 1946) has found that the serum of the snake *Heloderma* is capable of neutralizing the venom. Auto-antivenin was also found in the extract of liver but not in extracts from the venom gland, pancreas, kidney or spleen. The antivenin was found in the globulin fraction of the serum. The results are discussed in relation to biological and genetical problems.

Mitotic Hormone

H. H. DIXON (*Sci. Proc. Roy. Dublin Soc.*, 24, 119; 1946) provides illustrations of the fact that where nuclei of *Fritillaria imperialis* are not enclosed in a cell wall there is a synchronization of mitosis. For example, the nuclei in the cytoplasm lining of the embryo sac can be seen to be arranged in bands; the first bands are in prophase, and are followed in succession by bands of nuclei in the succeeding stages. The early stages of endosperm formation show similar formation. The author points out that the obvious synchronization, contrasted with its absence in nuclei enclosed in cell-walls, suggests that a hormone or chemical which stimulates mitosis is controlling the stages of mitosis. The estimated rate of travel of the chemical would indicate that it is crystalloid in nature.

Ambrosia Fungi

WOOD-BORING insects known as Ambrosia beetles feed upon certain fungi which grow in their galleries. Shirley Webb (*Proc. Roy. Soc. Victoria*, 57 (N.S.) Pts. 1 and 2, 57; 1945) has investigated these fungi, as they occur in Australia. *Leptographium Lundbergii* and two species of sporogenous yeasts belonging to the genus *Endomycopsis* are the species involved. Ambrosia fungi from different parts of the world belong to the genus *Leptographium*. The question as to whether the sporogenous yeasts serve the beetles as direct food, or whether they stimulate growth of the other species, is discussed. It is suggested that *L. Lundbergii* is the conidial stage of *Ceratostomella ipis*.

Botrytis Rot of Gladiolus

A SERIOUS corm rot of the gladiolus in Australia is caused by a fungus identical with *Botrytis gladioli*. G. C. Wade (*Proc. Roy. Soc. Victoria*, 57 (N.S.) Pts. 1 and 2, 81; 1945) shows that the fungus enters through the cut stem or the old corm. It spreads along the vascular bundles to cause extensive rotting, and can also infect the leaves and flowers. The fungus responds to increasing carbohydrate content in the presence of vitamins or plant extracts. It destroys the phloem before the xylem and forms an indicator pigment around the invading fungus. Control may be effected by dipping corms in corrosive sublimate or various proprietary dips.

Spore Discharge in *Daldinia concentrica*

THE fungus *Daldinia concentrica* is a conspicuous Pyrenomycete on dead ash wood. It is shown by C. T. Ingold (*Trans. Brit. Mycol. Soc.*, 29, Pts. 1 and 2, 43; May 1946) to be a succulent xerophyte capable of spore discharge over a long period of dry conditions. Ascospores are violently ejected to a horizontal distance of 1.0-1.2 cm., and the stroma decreases in density from about 1.0 to 0.2-0.3 during a period of

about 16-26 days in dry air. The succulent tissue of the stroma beneath the hard outer crust evidently acts as a reserve of water which appears to have an effect upon the duration of spore discharge. When part of it is removed, spore ejection ceases after a shorter period. A photo-electric method of measuring the density of spore suspensions was used in the investigation.

East Greenland Pack-ice

FLUCTUATIONS from year to year in the amount of arctic pack-ice are well known, but there is no consensus of opinion as to progressive changes towards more or less. F. Nansen could find no evidence of changes in climate, at least since the Middle Ages, in Greenland, and Th. Thoroddsen could not trace any climatic changes in Iceland. Dr. Lauge Koch has made an exhaustive study of historical records of the ice of East Greenland and Iceland (*Meddelelser om Grønland*, 130, No. 3. København) and has come to different and definite conclusions as to changes that have occurred in the amount of pack-ice. These changes must have had correlations in climate. His conclusions may be thus summarized: from 800 to 1200 there was scarcely any summer ice near Iceland and the southern half of Greenland; the amount increased until 1400 and then again decreased until 1600, when a rapid increase began which culminated about 1900 with large quantities of pack-ice during the summer near Iceland and southern Greenland; from 1920 to 1939 there has been little ice in these seas. The evidence is naturally confined largely to summer conditions. The volume is well illustrated with maps and fully documented.

The Cedartown, Georgia, Meteorite

STUART H. PERRY, associate in mineralogy, U.S. National Museum, has described the iron meteorite ploughed up at Cedartown at an unknown date, but prior to 1898 (*Smithsonian Mis. Coll.*, 104, 23; 1946). It weighs 25½ lb. and is lenticular in shape, its greatest dimensions being 9 in. × 11 in. The greatest thickness at its centre is about 3 in., and this diminishes to a thin edge all around. It was partially disrupted by its flight through the air, as a result of which it has a fissure extending inwards about 5 in. An analysis by E. P. Henderson showed that its percentage composition was as follows: iron, 94.02; nickel, 5.48; cobalt, 0.22; phosphorus, 0.30; sulphur, 0.04; chromium, 0.02. The house in which the meteorite was stored for some time was burned, and it may be assumed that it reached a temperature of about 560° C., but the normal microstructure showed no appreciable changes in consequence. This and other facts are consistent with experiments which have shown that changes in a body of this nature are produced only by prolonged heating, and the house which was burned was destroyed within an hour—too short a period of heat to effect any noticeable alterations.

Coppered-Tungsten Hard Glass Seals

VACUUM-TIGHT seals through hard glass with bare tungsten wire are difficult to make because leakage often occurs along the fine longitudinal cracks in the tungsten wires. A. L. Riemann (*J. Sci. Instr.*, 23, 121; June 1946) describes a process which overcomes this difficulty. The tungsten wire is first provided with an adherent and structurally sound sheath of copper, which flows into and fills up the cracks, and then the coppered wire is sealed into the glass appara-

tus. The coppered-tungsten seal requires a glass of slightly greater thermal expansivity than that suitable for bare tungsten. The process consists of six operations, all of which are described in detail. They are: (1) mounting and cleaning, (2) preliminary plating, (3) fusion in hydrogen, (4) main plating, (5) borating, and (6) beading and sealing up. A formula is derived giving the optimum thickness of copper coating to suit a particular glass, or the optimum glass expansivity to suit a given composite wire. Particulars are given of several successful seals made with wires of different diameters in C9 glass, uranium glass and Corning 704 glass, of expansivities 3.75, 4.1 and 4.9×10^{-6} per degree centigrade respectively.

Electric Contacts between Metallic Bodies

No satisfactory mechanism has as yet been proposed for the passage of current through electrical contacts between metallic conductors. Those so far advanced have been able to produce reasonable results only for contacts which can be regarded as gaps of very small width of not more than a few angstroms. Gaps of much larger width can, however, operate as good contacts, and judging from data relating to metallic powders and thin films, the electrical conductivity of such contacts apparently increases with rise in temperature. An explanation of these phenomena is suggested in a theoretical paper by J. Frenkel (*J. Physics U.S.S.R.*, 9, 489; 1945), in which the electrical contact between two metals is treated as a gap through which the electrons pass from one metal to the other by means of thermionic emission. The potential barrier, in virtue of the image forces, is lowered by reducing the gap, and thus the passage of the current is facilitated. The electrical conductivity, σ , of the gap is defined as the ratio of the resultant thermionic current through the gap, when an external homogeneous electric field E is applied, to the product of E and the width of the gap. For small values of E , σ is shown to be independent of E , as in the case of an ordinary conductor obeying Ohm's law. The expression derived for the increase of σ with rise in temperature is exactly similar to that found for the electrical conductivity of a semi-conductor, and on the assumption that the main part of the effective resistance is due to a large number of contact gaps between the metallic particles, phenomena observed with fine metallic powders and thin layers may be understood. A more exact and detailed calculation of the contact resistance based on the mechanism described is to be published in a special article later.

Analysis of Vibration Problems

CONSIDERABLE attention has been devoted during recent years to studies of the characteristics, measurement and reduction of vibration as it occurs in engineering equipment, with particular reference to the avoidance of noise during operation. In a paper recently published (*J. Inst. Elect. Eng.*, 93, Part 2; Oct. 1944), A. J. King discusses each of these different aspects of the problem and gives a comprehensive survey of the methods of vibration measurement now available, and advice on the principles to be followed in prescribing measures for its reduction. He also describes a moving-coil co-ordinate potentiometer apparatus developed for measurement, over the frequency range 10–110 cycles/sec., of the dynamic stiffness and damping of resilient materials, for use in reducing the transmission of vibration, and gives data for a range of representative materials.

Development of High-Voltage Gas Pressure Cables

THE development of high-voltage cables of the oil-impregnated lapped paper type, in which the effective electric strength of the dielectric is raised by subjecting it to a high gas pressure, has been proceeding in Great Britain for many years, and lengths of this type of cable are now in successful operation. The general principles involved in the design of joints and sealing ends for such installations have been discussed in a recent paper by L. G. Brazier (*J. Inst. Elect. Eng.*, 93, Part 2; Oct. 1946), with particular reference to a cable operating at 132 kV. and a gas pressure, provided by dry nitrogen, of 200 lb./in.². It is characteristic of laminated paper structures that their electric strength in the direction of the laminations is much less than that across them. This relative weakness against longitudinal stress is not removed by the application of gas pressure, and accounts for the special difficulties involved in designing joints capable of withstanding voltages of the high order mentioned above.

Methyl Bromide as a Delousing Agent

THE adoption of this compound as a delousing agent was the outcome of a series of experiments made to determine the value of available fumigants for delousing clothing and equipment. They were carried out by the U.S. Bureau of Entomology and Plant Quarantine at the request of the office of the Surgeon General of the Army. The foregoing title is that of Circular 745 (1946) of the U.S. Department of Agriculture written by R. Latta, H. H. Richardson and J. B. Kindler. After preliminary trials methyl bromide was selected as the fumigant best suited for the purposes required. At the time of the entry of the United States into the Second World War louse-borne typhus was a matter of vital concern for Army welfare. The advantages of methyl bromide are that it does not stain clothing, leaves no odour, is non-inflammable and does not react with articles, especially those of plastics, that might be part of the soldier's outfit. The dosage adopted for complete killing of all louse eggs was at the rate of 9 lb. per 1,000 cu. ft. of space for half an hour at 60° F. Methyl bromide fumigation proved to be the most potent weapon for mass delousing in the field during the early part of American participation in the Second World War, until the wholesale application of insecticidal powders proved the potentialities of that method.

The Deep Minimum in the Light Curve of Nova Herculis 1934

F. J. M. STRATTON (*Mon. Not. Roy. Astro. Soc.*, 105, 275; 1945) has offered an explanation of the deep minimum in the transition stage of the light-curve of Nova Herculis 1934 and also of Nova Cygni 1942. It is suggested that the vanishing of the absorption lines as well as the weakening of the continuous spectrum are due to an obscuring cloud passing between the earth and the nova, the opaque cloud forming inside the outer shell and passing across the central star, thus obscuring both the star and the inner shells. There is a short discussion on the nature of the obscuring cloud, and reference is made to Chandrasekhar's suggestion in 1939 that ejected matter from a nova might change its physical state and become particles or molecules. Some support for this view is afforded by the spectrum of Nova Pictoris 1925, and, while no final explanation is given on the nature of the obscuring cloud, it seems possible that it has some connexion with the outflowing atoms of carbon, nitrogen and hydrogen.

VARIATION OF COSMIC RADIATION WITH FREQUENCY

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MEASUREMENTS of cosmic radiation at 40, 90 and 200 Mc./sec. have been carried out recently in Britain, using directional aerial systems, and the observations at 40 and 90 Mc./sec. have been confirmed and extended to cover the full 360° of galactic longitude by various observers stationed in ships at other latitudes.

For comparison between observations obtained with different aerial radiation patterns, it is useful to reduce the results to some common denominator which is conveniently the equivalent noise temperature T_e of a hypothetical aerial having a beam-width narrow compared with the radiation pattern of the source.

If the aerial beam is rotated at right angles to the plane of the Galaxy, the observed noise temperature of the aerial T_o , as well as T_e , may be expressed as functions of galactic latitude ϕ , and 'energy widths' ϕ_o and ϕ_e can be assigned to these functions, defining the energy width of a noise temperature distribution

$T = A(\phi)$ as $\frac{1}{T_p} \int A(\phi) d\phi$, where the suffix p denotes the peak value of T . It may then be shown that

T_{ep} is given by $T_{op} \frac{\phi_o}{\phi_e}$. It is possible to deduce ϕ_e

from ϕ_o , given a knowledge of the aerial radiation pattern, but with the rather wide beams which had to be used at 40 and 90 Mc./sec. (about 35° in the vertical plane and respectively 70° and 35° in the horizontal plane to half power) the accuracy obtainable is rather poor. Observations were reasonably consistent with a figure of 35° for ϕ_e derived from the contours obtained at 64 Mc./sec. by J. S. Hey, J. W. Phillips and S. J. Parsons¹, and this value has been used as a basis for Fig. 1, which shows the

variation with galactic longitude of the noise increase associated with the equatorial plane of the Galaxy with respect to the noise-level obtained when the aerial is directed away from the galactic plane. The results of Hey, Phillips and Parsons, replotted on the same basis, have been included for comparison, and it will be noticed that there is a good measure of consistency between results at the various frequencies, except that the peak in Cygnus is largely smoothed out at 40 and 90 Mc./sec. owing to the use of relatively wide beams.

In the region of minimum noise, the probable experimental error at 40 and 90

Mc./sec. is of the order of 2 or 3-1, and too much significance should not be attached to the apparent peak at 190° which has not appeared in all the sets of observations and is inconsistent with the contours obtained by Reber². It has been assumed that ϕ_e is constant, and this appears to be roughly true for the variation with galactic longitude according both to Reber and to Hey, Phillips and Parsons, although the contours of the latter suggest some narrowing in the region of Cygnus. According to Reber, ϕ_e appears to be of the order of 18° at 160 Mc./sec., and this apparent narrowing with increase of frequency is supported by the 200 Mc./sec. measurements, though not conclusively owing to the low noise-level at this frequency and consequent difficulty of making accurate observations.

The full-line curves of Fig. 1 have been plotted from one particular set of observations obtained at lat. 52° N. and involving probable errors somewhat smaller than those of the majority of the results available. The aerial beams were directed horizontally and, taking account of ground reflexion, were estimated to intersect the Galaxy at a few degrees above the horizon. Observations at angles less than 60° between the horizon and the plane of the Galaxy have been ignored in order to simplify the calculations.

The dotted curve is based, as regards shape, on records obtained by S/Lt. Cummings, during a voyage to Australia, for the condition when the planes of the Galaxy and the horizon were coincident. It is also a reasonable mean curve through a large number of observations made with the planes at approximately right angles.

The variation of noise-level with frequency is illustrated by the upper curve in Fig. 2 for 350° galactic longitude, and the slope of the curve gives the relation

$$T_{ep} \propto \frac{1}{(\text{frequency})^{2.7}}$$

It is considered that this is just near enough to an inverse cube law for the difference to be attributable

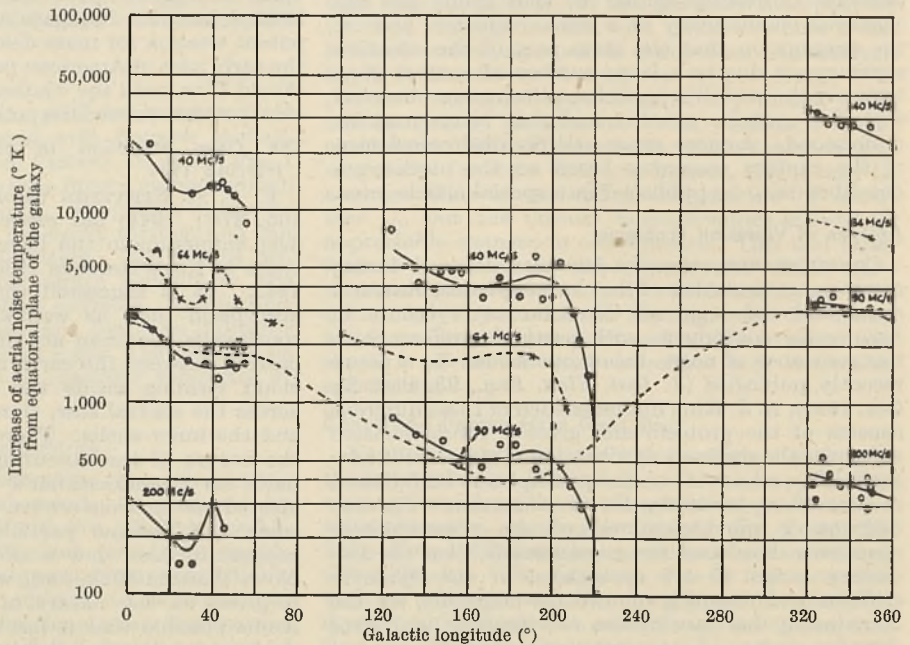


Fig. 1

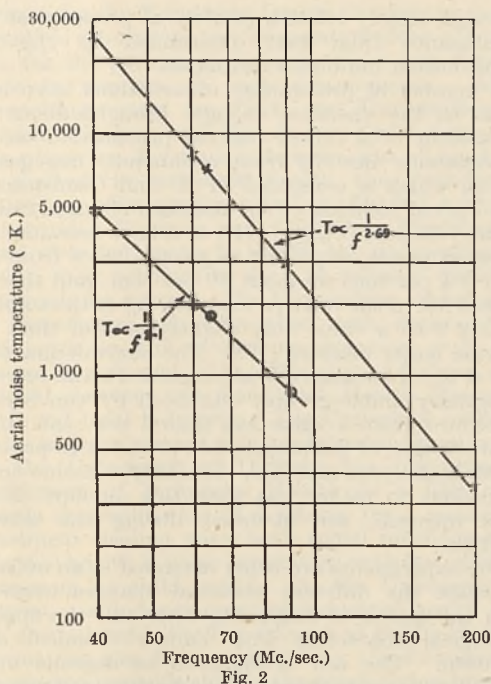


Fig. 2

to possible errors in observations. No significant variation of index with galactic longitude has been noticed. It will be appreciated that the index is not dependent on the value assumed for φ_e , although it is affected by any variation of φ_e with frequency.

The minimum noise-level was found to be considerable. It is plotted in Fig. 2 as a function of frequency, and is of the form

$$T_e \propto \frac{1}{(\text{frequency})^{2.1}}$$

the index is likely to be high, if anything, owing to the rather poor bearing-discrimination of the 40 Mc./sec. aerial. Aerial side lobes could account for an error of at most 5 per cent in index. Mismatching at the receiver input can cause an error in the observed minimum temperature by altering the receiver noise-level, but this possibility was eliminated by careful matching in the case of the measurements used as the basis of Fig. 2. Other possible sources of error are terrestrial interference too weak to be detected by ordinary methods, and zero shift during the measurements. The latter has been minimized by averaging the readings obtained over a 24-hour period, and reasonable consistency between measurements with various installations enables interference to be excluded except as a possible cause of some of the fluctuations experienced, which usually amounted to not more than +60 per cent relative to the absolute minimum. It is considered, therefore, that the apparent difference in law is sufficiently well founded to be worth recording.

The subtraction of the minimum level in deriving Fig. 1 has the advantage of avoiding the above sources of error, and is also required by the present lack of evidence to justify recording the minimum level as galactic noise. The difference in frequency-law implies either the existence of two kinds of noise, or of frequency-selective attenuation by interstellar matter. In the absence of a suitable theory, and in view of the apparent constancy

of frequency law with galactic longitude, the attenuation hypothesis appears unlikely, and it is suggested that the minimum noise-level may perhaps be accounted for by secondary radiations from the earth's atmosphere; on the other hand, an aerial directed away from the plane of the Galaxy must possess some noise 'temperature' of galactic and some of extra-galactic origin, and an estimate of these effects may be essential to a full explanation of the observations.

In view of the much-discussed hypothesis that galactic noise is analogous to the noise associated with solar flares, a comparison of the variation with frequency for the two cases is of interest. The data available for solar noise are rather scanty, but unpublished measurements by H. M. Bristow and his colleagues indicate that the variation with frequency is very much more rapid than that shown in Fig. 2, thus tending to support the contention of Greenstein, Henyey, and Keenan³ that this is an entirely different type of phenomenon.

I am indebted to many of my colleagues for their assistance in carrying out the measurements described, and in particular to H. Suhl for his valued collaboration in the mathematical aspects of the work.

¹ Hey, J. S., Phillips, J. W., and Parsons, S. J., *Nature*, **157**, 297 (1946).

² Reber, G., *Astrophys. J.*, **100**, 279 (1944).

³ Greenstein, J. L., Henyey, L. G., and Keenan, P. C., *Nature*, **157**, 806 (1946).

ENZYMIC DECOMPOSITION OF A, B AND O SPECIFIC BLOOD-GROUP SUBSTANCES

By DR. W. T. J. MORGAN

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SCHIFF¹ observed that cultures and culture filtrates of certain strains of *Clostridium welchii* possess the power to inactivate the blood-group A-substance contained in peptone and human saliva. The decomposition was considered specific for A-substance. We have examined a number of crude *Cl. welchii* filtrates for their capacity to destroy the specific blood-group substances, but have found them disappointingly weak. Through the kindness of Dr. W. E. van Heyningen, who has supplied a number of *Cl. welchii* (Type A) culture filtrate preparations partially purified with reference to collagenase (α -toxin)², it has been possible to study the action of the enzymes contained in these preparations on the blood-group substances. The filtrates contained collagenase and hyaluronidase³, and in most specimens α - and θ -toxins were also present. The substrates used were preparations of A-substance obtained from hog gastric mucin⁴ and A-, B- and O-substances which had been isolated from human pseudomucinous ovarian cyst fluids⁵. The human A- and B-substances showed no significant O specificity. The A-substance isolated from hog mucin, although electrophoretically homogeneous at pH 4.0 and 8.0, nevertheless is composed of two mucoids, one of which possesses A specificity and the other O specificity. The mixed material, which is usually referred to as 'hog mucin A-substance', cannot be separated readily into its serologically specific A and O components by any of the simple chemical or physical techniques employed so far, but full details of this aspect of the dual specificity

of hog mucin 'A-substance' and of preparations of A- and B-substances isolated from the saliva and gastric juice of persons belonging to groups A, B and AB will be discussed elsewhere.

Overnight incubation (37°) of the enzyme preparation with the blood-group substances in the presence of toluene destroys almost completely their specific, serological characters as measured by the usual iso-agglutination inhibition technique. It was observed, however, that whereas the enzyme preparations after heating for one hour at 56° fail to decompose the gastric mucin A-substance or the human A- and B-substances, they nevertheless rapidly and completely destroy the O characters of the hog mucin preparation and of the human O-substance. It would appear, therefore, that there are at least two enzymes present in the partially purified and concentrated *Cl. welchii* filtrates, one of which is thermolabile and decomposes the A- and B-substances; the other is thermostable and attacks and destroys the O-substance only.

One *Cl. welchii* filtrate examined was found to decompose the A- and B-substances but to be without action on the O-substance. Under controlled conditions of growth and heat inactivation, it is therefore possible to obtain an enzyme preparation which will destroy either the A- and B- or the O-characters of the blood-group substances.

The destruction of the serological activity of the A- and B-substances by the enzyme preparations is prevented by an anti-serum produced against *Cl. welchii* filtrates. An anti-serum of this kind contains α -antitoxin, θ -antitoxin, anti-hyaluronidase and anti-collagenase, and almost certainly possesses antibodies against other unidentified antigenic components present in the original culture filtrates. The anti-serum, however, fails to inhibit the action of the thermostable enzyme responsible for the destruction of the O-substance. This is conceivably due to the poor antigenic quality of the enzyme when in competition with the antigenically active α - and θ -toxins, hyaluronidase and collagenase.

Certain preparations of *Cl. welchii* α - and θ -toxins have been examined which have had no action on the specific serological characters of the A- and B-substances, and it may be accepted, therefore, that these toxic components have no action *per se* on the A- and B-substances. Preparations of α - and θ -toxins, however, which decompose the O-substance, continue to do so after these toxic components are completely neutralized by α - and θ -antitoxin respectively. The α - and θ -toxins have, therefore, probably no action on the serologically specific O-character of the O-substance of human or animal origin. A preparation (1,000 v.r.u. per ml.) of *Cl. welchii* hyaluronidase kindly supplied by Dr. Rogers was found to be without action on the A- and B-substances, but rapidly and completely destroyed the serological activity of the O-substance, presumably by virtue of the heat-stable enzyme that is common to most *Cl. welchii* filtrates and not by the action of hyaluronidase, for preparations of streptococcal, staphylococcal and testicular hyaluronidase fail to decompose the A-, B- or O-substances.

It has been found that most of the enzyme preparations fail to destroy the A-activity of the human or animal A-substance when this character is measured by the hæmolytic inhibition test. The hæmolysis test is generally believed to measure the 'Forssman' or heterophile component of the A-agglutinin, and is accepted as measuring a different,

although closely related, serological property of the A-substance from that determined by the iso-agglutination inhibition technique.

A number of preliminary observations have been made on the chemical changes brought about by the action of a mixed enzyme preparation on the 'A-substance' derived from commercial hog gastric mucin, which is composed of A- and O-substances. The optical rotation of the material changes from a dextro rotation, $[\alpha]_{546.1} + 11^\circ$, to a lævo rotation, the reducing power, expressed as glucose, rises from less than 0.5 per cent to about 10 per cent, and there is a rapid fall in the relative viscosity (η) of the solution from 2.9 to a value only slightly greater than the enzyme buffer mixture (1.0). The enzymic inactivation of the A-substance is accompanied by an increase in primary amino-groups, estimated by van Slyke's procedure, from a value less than 1 per cent of the total nitrogen of the preparation to about 13 per cent in the hydrolysed material. Similarly, α -amino-acids, equivalent to rather less than this amount of the total nitrogen, are liberated during the decomposition.

The experiments are being extended in an attempt to relate the different chemical changes observed with the action of single enzymes, and the specific serological characters with known chemical constitution. The use of enzymes to degrade other serologically active mucopolysaccharides and mucoids is under investigation.

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⁵ Morgan, W. T. J., and van Heyningen, R., *Brit. J. Exp. Path.*, 25, 5 (1944). Morgan, W. T. J., and Watkins, W. M., *Brit. J. Exp. Path.*, 25, 221 (1944). King, H. K., and Morgan, W. T. J., *Biochem. J.*, 38, X (Proc.) (1944). Morgan, W. T. J., and Waddell, M. B. R., *Brit. J. Exp. Path.*, 28, 387 (1945).

THE NUFFIELD FOUNDATION

THE first report of the trustees of the Nuffield Foundation, covering the three years ended March 31, 1946, recapitulates the main objects of the Foundation, and indicates briefly the general policy and procedure which have governed the drawing up of the programme for the years 1944-45 to 1949-50 covering five main fields: the medical, the natural and the social sciences, fellowships and similar awards and the care of the aged poor. Total grants made by the Foundation during these three years amount to £882,820, and the policy and details of grants in the particular fields are described further in separate sections of the report.

In regard to medical sciences, the Foundation seeks to assist, first, the proper understanding, definition and maintenance of the optimum conditions of health in varying human circumstances, and secondly, the proper relation between preventive and curative medicine. The Foundation has co-operated in the fulfilment of the University of London's plans for the creation of an Institute of Child Health by endowing the whole-time professorship to be held by the director of the Institute; but, in view of the sums made available by the Government for dis-

tribution by the University Grants Committee in aid of medical education, the Foundation does not propose, for the present at least, to make any further grants in support of such departments. After approaching, early in 1944, the Universities of Durham, Glasgow and Manchester and learning of their plans for developing departments of teaching and research in industrial health, the Foundation decided to offer grants totalling £40,000 each to Durham and Glasgow and £70,000 to Manchester, spread over ten years, to enable the universities to develop their schemes as soon as suitably qualified staffs could be secured. The Universities shared with the Foundation the view that such departments must work in the closest co-operation with the Factory Department of the Ministry of Labour and National Service, the Industrial Health Research Board and local industries. The University of Manchester has now created a full professorial department, and the University of Durham has instituted a Department of Industrial Health as a first step towards the realization of a scheme for a combined department dealing with both social medicine and industrial health in close association with the existing department of child health. At the University of Glasgow, a sub-department of industrial health has been created inside the Department of Public Health. A grant has also been promised by the Foundation towards the research side of the combined industrial health and rehabilitation scheme at Slough, while in the field of dental health grants have been offered to the Sutherland Dental School, Durham, the Guy's Hospital Dental School, the Turner Dental School, Manchester, and the School of Dentistry at the University of Leeds. Grants have also been made to the University of Oxford in aid of the Nuffield Laboratory of Ophthalmology, and for research on nasal catarrh at the University of Manchester and the Manchester Royal Infirmary.

In regard to the natural sciences, the main concern of the trustees is to encourage and assist basic studies in universities by providing resources in advance of normal university standards, and during the present period most attention has been given to the physical sciences. Grants have been made to the Department of Physics, University of Birmingham, in aid of research to be carried out in Prof. M. L. E. Oliphant's department; to the Department of Natural Philosophy, University of Glasgow, for research work which Prof. P. I. Dee is developing in nuclear physics; to Birkbeck College, London, for the research laboratory on biomolecular studies which is being established under the direction of Prof. J. D. Bernal; and to the Department of Physics, University of Manchester, to expand and improve the technical laboratory services for research work on cosmic rays under Prof. P. M. S. Blackett. Grants to the Clarendon Laboratory at Oxford amounting to £64,000 over eight years will be an extra endowment for additional research fellowships, special technical assistants and the purchase of special research equipment and material. A grant of £1,500 a year for five years has been allotted to the Cavendish Laboratory for a special research fellowship for Dr. E. Orowan to enable him to continue his work at the Laboratory and to contribute to the cost of his work on fundamental problems of the metallic state. The Foundation has also placed at the disposal of the University of Cambridge a grant of £10,000 over a period of five years towards the cost of a joint investigation by the School of Agriculture and the

Laboratory of Engineering on the mechanical properties of soil. This grant is intended to meet the salaries of qualified scientific assistants, laboratory assistants and the provision of special material and equipment.

In regard to the social sciences, which the Foundation interprets as implying disinterested scientific study of the structure and operation of human society, of the part played by individuals and groups of individuals in social organisations, and of the impact and effects on individuals of social institutions and relations, the trustees have so far been able to do little more than settle the broad outlines of the policy to be followed. It is intended that the funds earmarked for this purpose shall be used mainly in assisting selected universities to improve their staff and facilities for social and economic research, particularly for the realistic and quantitative investigation of social and economic problems. Where possible, encouragement will be given to investigations involving team-work by experts in different fields. In selecting universities, the trustees will look in the first place for men and women interested in realistic research and capable of building up vigorous research schools. Occasionally support will be given to the teaching and research activities of non-university bodies of high academic repute, and grants promised during the period covered by this report include an annual grant of £3,000 for five years to the general budget of the National Institute of Economic and Social Research, a similar grant to the Population Investigation Committee towards its programme of research into population problems, and grants to a total of £10,000 over five years to be used for scholarships at the National Administrative Staff College to students of merit who, without assistance, could not attend the College.

Describing the policy of fellowships, scholarships and similar awards to which the trustees proposed to devote a substantial portion of the Foundation's income, the report refers to visiting lectureships, seconding and interchange of teachers and others, and collaboration with the Dominion Students' Hall Trust as included in the programme. Schemes already instituted include the Nuffield medical fellowships in social medicine, child health, industrial health, and psychology, Nuffield dental fellowships and scholarships, an offer of £5,000 towards the interchange training scheme of the British Committee for the International Exchange of Social Workers and Administrators, the Colonial Service Scholarships and a similar, limited scheme for officers of the Sudan Government Service, a programme of Dominion medical travelling fellowships to facilitate post-graduate training and experience in Great Britain, awards for six Maltese demonstratorships and for a number of Alderney training bursaries.

In regard to care of the aged poor, the Foundation has sought first to provide itself with a proper basis of knowledge on which to decide future action, and has initiated a survey of the problems of ageing and of the care of aged people, under a committee of which Mr. B. Seeborn Rowntree is chairman, with a medical sub-committee on the causes and results of ageing under the chairmanship of Dr. A. S. Parkes. A grant of £20,000 has been accepted by the University of Cambridge for an investigation at the psychological laboratory under Prof. F. C. Bartlett, which will deal with the characteristics and changes of human functions associated with different age-groups, with particular reference to adult groups.

Among miscellaneous grants, the report refers to one of £9,000 to the Imperial Agricultural Bureau to accommodate the Empire potato collection, and one of £1,500 to the Medical Research Society to permit purchase of the assets of the journal *Clinical Science* and to prevent a rise in price of the journal during the next five years.

UNITED STATES NATIONAL MUSEUM

REPORTS FOR 1944 AND 1945

THE extensive work carried out by the United States National Museum in the interest of the war effort is an outstanding feature of the report for 1944 (Washington, D.C.: Gov. Printing Office, 35 cents). Under the heading, "The Museum in War-time", the chief of the departmental services rendered are described. Some of these include the following: Dr. Kellogg's preparation (for the National Research Council) of text and illustrative matter relative to monkeys known to be susceptible to infection by malarial parasites; the supply to various organisations of the Services of information regarding the identification and distribution of mammals involved in the transmission of diseases; the provision of information relating to the habits of certain mosquitoes, mites and ectoparasites sent in for identification by various Army and Navy units; the supply (to Army and Navy medical and other training centres throughout the country) of several hundreds of specially mounted specimens of insects and Acarina species involved in human health problems; suggestions for tropical and Arctic clothing; information regarding water supply and population statistics of the Caribbean Islands, house types in Burma, and the degree of western influence in certain Pacific islands and in the Philippines; the provision of information (based on collections in the Department of Anthropology) regarding the resources of certain strategic areas, and so on.

During 1944, Dr. G. A. Cooper concluded his field studies on the stratified rocks of Sonora, and it is reported that the results of his work (to be published shortly) will assist in the location of new mineral areas. Dr. Cooper also finished field-work on a project concerned with the Devonian sub-surface geology of Illinois, and information has been obtained which will be useful for the oil development of that and neighbouring States. Other work connected with the Department of Geology included the continued supervision by W. F. Foshag of surveys for strategic minerals in Mexico.

Under the section of the report dealing specifically with the activities of the Department of Geology, reference is made to the present-day scientific value of plaster casts of type fossils—"in view of the destruction taking place in foreign museums". In this connexion, mention is made of a cast of the English Carboniferous crinoid, *Poteriocrinites crassus* Miller, received as a gift from the British Museum (Natural History). The holotype and only specimen of this was housed in the Bristol Museum, which was destroyed by enemy action during the War.

The report ends with a 28-page list of accessions, and a list of the Museum's publications issued during the fiscal year 1943-44.

The report for 1945 of the United States National Museum (25 cents) comments on the necessity for additional housing space if the progressive work of the Museum is not to be hindered. In this connexion, allusion is made to the wealth and utility of the Museum's scientific materials in the future development of American natural resources, agriculture and industry. Congress has already authorized the addition of wings to either end of the Natural History Building as soon as public building projects are possible, and now plans for separate buildings for engineering and industries and for American history have been estimated for authorization. The proposed engineering and industries building would take the place of the present arts and industries building, which is, to quote the report, "an antiquated brick structure . . . no longer suitable for modern installations in museum display".

JOHN INNES HORTICULTURAL INSTITUTION

ANNUAL REPORT

THOSE who are acquainted with the limitations of space under which the John Innes Horticultural Institution has laboured in past years will welcome the forthcoming transfer to its new site at Bayfordbury Park, Hertfordshire, already described in *Nature* (156, 586; 1945).

The thirty-sixth annual report of the Institution, for 1945, covers a very wide field of investigation.

The replacement of existing virus-infected, low-yielding clonal stocks of raspberries is a pressing necessity. M. B. Crane's work on high-yielding F_1 families of seedling raspberries promises to provide a rapid method of producing virus-free seedling stock of sufficient uniformity. He records that the yield of the best hybrid family is 60 per cent higher than that of a selected stock of Norfolk Giant. Further extensive trials of F_1 families planted in 1945 have been bred for greater uniformity, especially in respect to firmness and colour of fruit.

Several investigations on the tomato are in progress; A. G. Brown, working on hybrid vigour, reports in all cases considerably higher yields from F_1 families than from either parent. A breeding investigation aimed at combining high yield with early maturity is in progress. Dr. D. Lewis is endeavouring to obtain a degree of frost hardiness in hybrids derived from crosses between certain wild species of tomato, collected from high altitudes in Peru, and cultivated varieties. Messrs. W. J. C. Lawrence and J. Newall have shown, notably in tomatoes, that earliness and total yield depend to a remarkable degree on seedling treatment designed to avoid any check to rapid development. Factors of great importance are the minimizing of root disturbance by pricking out small seedlings directly into pots, and the employment of pots sufficiently large to allow unrestricted root development. Further experiments show the importance of adjusting the fertilizer balance and concentration in the seedling compost to an optimum level, and the feeding of root-bound plants with a balanced fertilizer prior to transplanting. In winter, however, the influence of reduced light intensity in glasshouses is shown to be of over-riding importance, outweighing all other factors.

The production, in certain varieties of apple, of diploid pollen by heat-shock treatment of the pollen mother cells has enabled Dr. D. Lewis to raise triploids from diploid varieties, including varieties Northern Spy and Beauty of Bath. The induced triploids have the marked advantage, in a highly heterozygous plant, of possessing a complete diploid genotype from one parent, while segregation in the female parent provides for limited variation. Triploids from Northern Spy should provide a vigorous rootstock immune to woolly aphid.

Dr. A. J. Bateman, working on the isolation requirements of crops grown for seed, has demonstrated that, in all crops investigated, contamination between adjacent blocks of varieties falls to 1 per cent or less at a separation of 150 ft., even in conditions under which it is most favoured, in both wind- and insect-pollinated crops. He suggests that growers' reports of serious contaminations over distances of furlongs or even miles are better explained by contamination in a previous generation masked by dominance or genic interaction.

Dr. C. D. Darlington, the director, refers to work on the effects of X-rays on the pollen mother nuclei of *Tradescantia bracteata* during meiosis. Low dosage (45r.) led to end-to-end association of pairs of bivalents at metaphase, due not to breakage and reunions between non-homologous chromosomes, but to crossing-over between the segments of different chromosomes usually regarded as non-homologous. Breakage and reunion do occur, but exclusively within single chromosomes, to give centric or acentric rings. This suggests that the chromosomes before meiosis appear to behave as isolated units.

Further investigations upon which reports are submitted include trials of Merton varieties of cherries and haricot beans; trials of bush and dwarf tomatoes; incompatibility in polyploids with reference to *Oenothera organensis*; mutation and the production of self-fertile fruits in sweet cherries and *Oenothera*; the action of camphor, lactic acid, D.D.T., 'Gammexane' and sulphonamides on cell division; primary and secondary pairing in polyploids; artificial drying of seeds in relation to viability and germination; interspecific sterility and incompatibility in *Rubus*; the analysis of polygenic inheritance; and breeding systems and genetic isolation with reference to certain *Antirrhinum* species.

STRUCTURE AND MECHANICS OF THE PROTOZOAN FLAGELLUM

HARLEY P. BROWN has made an important contribution to our understanding of this subject (*Ohio J. Sci.*, 45, No. 6, 247; 1945). His paper begins with an extensive and highly critical review of the great amount of work already done on the morphology of the flagellum, and more than a hundred authors are mentioned.

An account is then given of the author's own investigations using the electron microscope. The section gives useful advice as to the preparation of the specimens for this new technique, and the results are shown in twelve beautiful plates, each with a micron scale. It is concluded that each flagellum is of approximately uniform diameter throughout and consists of a denser axial core surrounded by a less dense sheath, though in *Euglena* and *Astasia* the core appears to consist of two closely

approximated fibres of equal size. The sheath seems to contain, or to consist of, a spirally coiled fibre surrounding the core. The flagella of *Euglena* and *Astasia* have also, along one side, what appears to be a single row of delicate filaments extending out from the sheath; their length is about five or six times the flagellar diameter, namely, 1.5–2.0 μ . The long flagellum of *Ochromonas* bears similar filaments probably on all sides, but that of *Chilomonas* is devoid of filaments.

The mechanics of the flagellum is then considered and investigated by ingenious experiments. The motion of the flagellum was rendered visible by mounting in a viscous solution of methyl cellulose. In every case, the wave impulse travelled from the base towards the tip, in a spiral course, producing rotation of the tip. All these observations directly support conclusions arrived at by A. G. Lowndes¹. A model flagellate was also constructed, and the author swam completely immersed, gyrating one or both arms in a relatively narrow cone. These experiments again confirm Lowndes' hypothesis, and show further that rotation of the gyrating object is not necessary for the production of a forward component, since mere gyration of an object (arm or flagellum) can produce an effective locomotor force.

It is thus shown that Lowndes was correct in stating that: (a) the flagellum beats in spiral undulations; (b) the waves of contraction progress from the base towards the tip of the flagellum, and often increase in amplitude as they progress; (c) the flagellum serves to push, rather than to pull, the organism through the water, although it arises from the anterior end of the body; (d) that rotation and gyration of the body alone may account for the locomotion of many flagellates.

This work should finally dispose of the view that the flagellum acts as a tractellum and draws the body forward. It constitutes one more reaction to the scientific stimulus produced by Gray's book "Ciliary Movement".

W. R. G. ATKINS

¹ Lowndes, A. G., *Nature*, 138, 210 (1936). *Proc. Zool. Soc. Lond.*, 114, 325 (1944).

EXPERIMENTAL MORPHOLOGY: SHOOT APICES IN STERILE CULTURE

IN a paper of very considerable interest, Dr. E. Ball (*Amer. J. Bot.*, 33, No. 5, 301; 1946) has described the development in sterile culture of shoot apices and subjacent regions of *Tropaeolum majus* and *Lupinus albus*. The work, which is directed towards the solution of problems of development and differentiation at the shoot apex, depends on a precise technique of dissection, which is described, on observations of the development of the experimental materials in synthetic culture media, and on a detailed histological examination of the growths eventually produced.

Dr. Ball has been able to show that minute apical segments, comprising the terminal meristem, will grow in culture media and eventually develop into entire plants. The shoot apex of *Tropaeolum*, which has a lower respiratory rate than its subjacent tissues, will only grow into a complete plant when submerged in the agar medium. Comparable apices of *Lupinus*, which have the highest respiratory rate of the shoot, will only grow into complete plants if placed on the surface of the agar. Hence primary

meristems are not all characterized by a low oxygen consumption. The polarity of shoot apices was not altered by being orientated away from the vertical position. Indeed, the evidence suggests that the shoot apex controls the geotropic response of the subjacent tissues.

Plants grown from excised apices developed normal though small vascular systems, that is, in circumstances in which the influence of the older vascular tissues had been eliminated. Such development demonstrates the independent, self-determining nature of the apical meristem.

Small segments of the tissues subjacent to the apical region grew best in aqueous medium to which unautoclaved coconut milk had been added. Those of *Lupinus* produced spherical masses that usually grew by cambium-like zones considerably beneath the original cut surfaces. Internally, this cambium produced parenchyma and very short tracheal elements; externally, it produced parenchyma and some cells that were apparently sieve-tube elements. In contrast, the subjacent tissues of *Tropaeolum* had various regions of superficial cells that underwent rapid mitoses. The end result was an irregular mass of parenchymatous cells that only infrequently contained groups of tracheal elements. In neither plant did the callus give rise to roots or buds. The original polarity of these subjacent regions was not retained in culture.

The results obtained suggest that there is a decreasing capacity for growth and development on proceeding basipetally along the shoot. The indications thus are that not all living plant cells are possessed of unlimited capacity for development, full meristematic potentiality being restricted to a few tissues only. The shoot apex possesses the greatest capacity for development of the entire plant; tissues subjacent to the shoot apex possess this capacity to a limited extent only. This interpretation is contrasted with other suggestions in the literature that theoretically every living plant cell is capable of producing any cell organisation characteristic of the species.

ASTRONOMICAL TELESCOPES

PROF. H. H. PLASKETT delivered his presidential address on February 8, 1946, to the Royal Astronomical Society, taking "Astronomical Telescopes" as his subject; the address has now been published (*Mon. Not. Roy. Astro. Soc.*, 106, 1, 80). There has been a tendency for some time to belittle the observational work that can be carried out at observatories in Britain, and some have even expressed the view that in the interests of efficiency the university observatories should be closed down. Others, while not quite so extreme in their attitude towards British climatic conditions, have suggested that if money for new telescopes should become available in Britain, these telescopes should be erected in some more or less remote part of the Commonwealth where better observing conditions prevail. Prof. Plaskett believes that these views are fundamentally wrong, and submits an alternative view under a number of headings; a brief outline of his proposals follows.

Most branches of astronomical research show the necessity for a large telescope in Britain, and Prof. Plaskett selects the physical interpretation of stellar spectra as an example. Although we cannot ignore

the contributions made by astronomers and physicists in other countries, the interpretation of stellar spectra was primarily a British achievement; but the research was seriously handicapped because of the lack of a large reflector. It was impossible to apply the theory of Fowler and Milne to the determination of the temperature and pressure in the atmospheres of individual stars since large reflectors, which alone can supply high-dispersion stellar spectra, were not available. As a result, the next step was taken by Russell and Adams in 1928 at the Mount Wilson Observatory with the stellar spectra obtained at the coudé focus of the 100-in. telescope. Theoretical work both at South Kensington and at Mount Wilson was carried out in the closest collaboration with observers at the place where observational and experimental material was available, and it is pointed out that if university observatories are moved from Britain to more suitable climates, the theorists will ultimately follow them. For this reason it seems inevitable that the disappearance of British university observatories as centres of observational astronomy would imply the disappearance of astronomy and related branches of science. Prof. Plaskett pleads for the establishment of at least one large telescope in Britain, and after examining various kinds of telescopes, concludes that the most suitable would be an instrument of the Schmidt type with a mirror of 74-in. aperture, suitable for both direct photography and slit-spectroscopy. The estimated cost with a number of accessories would be less than £100,000. (Reference may be inserted here to the announcement by the president of the Royal Society at the opening of the Newton tercentenary celebrations that the Government has agreed to the construction of a 100-in. reflector. See *Nature*, July 20, p. 90.)

A suitable site for such a telescope should be obtained in a place remote from any of the universities provided with their own observatories, and, as an ideal arrangement, the astronomical activity of the university and private observatories would be centralized about this telescope. While undergraduate instruction would still be continued at the various universities, graduate instruction would be carried out primarily at this "Central University Observatory". Such centralization would permit of a department for the study of applied optics which would have as its primary function the theoretical study of various forms of optical instruments. In addition, it would permit of a modern laboratory for spectroscopic research—a most important branch in connexion with future developments in astrophysics. Various suggestions are made with regard to the board of management and other matters which are merely questions of detail—easily settled once the principle of a central university observatory is admitted.

Objections on the grounds of the unsuitability of the British climate are considered, and Prof. Plaskett shows that these are very much overdone. The fact that Herschel, Lord Rosse and Common did such excellent work with large instruments suggests that seeing conditions in the British Isles are at least comparable with those prevailing in other places where large instruments are used. The infrequency of clear nights is also advanced as an argument against large telescopes; but, as Prof. Plaskett points out, the less frequent the opportunities for observation, the more efficient must be the instrument and its mounting to take advantage of these fleeting opportunities. Indeed, the very rarity of suitable nights demands the best possible instrument.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, November 25

INSTITUTE OF PHYSICS, LONDON BRANCH (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. R. C. Oldfield: "Psycho-Galvanic Reflex".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "The Heat Pump" (to be opened by Mr. J. A. Sumner).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (in Reynolds Hall, College of Technology, Manchester), at 5.30 p.m.—Symposium on "Industry and Education".*

INSTITUTION OF THE RUBBER INDUSTRY, MANCHESTER SECTION (at the Engineers' Club, Manchester), at 6.15 p.m.—Mr. Maldwyn Jones: "The Impact of Plastics on the Rubber Industry".

Tuesday, November 26

CHADWICK PUBLIC LECTURE (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 2.30 p.m.—Prof. H. J. Collins: "Some Aspects of Structural Engineering" (Bossom Gift Lecture).*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Harold Spencer Jones, F.R.S.: "Three Astronomical Centenaries, 1, Tycho Brahe, Born 1546".*

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "The Economics and Subjective Requirements of Television Picture Sizes" (to be opened by Mr. D. C. Birkinshaw).

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5.30 p.m.—Dr. Józef Obrebski: "Changing Peasant Culture in Poland".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, PHYSICAL METHODS GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Annual General Meeting. Short papers on "Polarographic Analysis".

TELEVISION SOCIETY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Mr. C. L. Hirschman: "Television Picture Quality".

SOCIETY OF INSTRUMENT TECHNOLOGY (at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London, W.1), at 7 p.m.—Mr. C. N. Jaques: "Aircraft Instrumentation in Test Flying".

Wednesday, November 27

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 5 p.m.—Sir Stephen Tallents, K.C.M.G.: "The Documentary Film" (Cobb Lecture).

SOCIETY OF CHEMICAL INDUSTRY, MICROBIOLOGICAL PANEL OF THE FOOD GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.15 p.m.—Mr. H. C. S. De Whalley and Miss M. P. Scarr: "Micro-organisms in Raw and Refined Sugar and Intermediate Products".

CHEMICAL SOCIETY, LIVERPOOL SECTION (joint meeting with the LOCAL SECTION OF THE ROYAL INSTITUTE OF CHEMISTRY, in the Chemistry Lecture Theatre, The University, Liverpool), at 7 p.m.—Mr. A. V. Billingham: "The Development and Industrial Application of Wetting Agents".

Thursday, November 28

BRITISH GLACIOLOGICAL SOCIETY (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 4.30 p.m.—General Meeting: at 5.15 p.m.—Dr. B. Cwilong: "Observations on the Incidence of Super-cooled Water in Expansion Chambers and on Cooled Solid Surfaces"; Dr. M. Perutz: "Description of the Iceberg Aircraft Carrier and Experiments on the Bearing of the Mechanical Properties of Frozen Wood Pulp upon some Problems of Glacier Flow".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. N. F. Mott, F.R.S.: "Problems before Theoretical Physics, 2".*

ROYAL STATISTICAL SOCIETY, INDUSTRIAL APPLICATIONS SECTION SHEFFIELD GROUP (in Room B1, Department of Mechanical Engineering, The University, St. George's Square, Sheffield), at 6.30 p.m.—Mr. D. Newman: "The Efficiency of 100% Inspection".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Princes' Gate, London, S.W.7), at 7 p.m.—Prof. G. I. Finch, F.R.S.: "Electron Diffraction and Surface Structure".

TEXTILE INSTITUTE, YORKSHIRE SECTION (at the University, Leeds), at 7 p.m.—Mr. M. Lipson: "Wool Research in Australia".

SOCIETY OF DYERS AND COLOURISTS, WEST RIDING SECTION (at the Great Northern Victoria Hotel, Bradford), at 7.15 p.m.—Mr. M. H. Wilkinson: "The Bleaching of Animal Fibres by Modern Methods".

INSTITUTION OF STRUCTURAL ENGINEERS, LANCASHIRE AND CHESHIRE BRANCH (at the College of Technology, Manchester)—Mr. H. E. Manning: "Developments in Reinforced Concrete Cooling Towers".

Friday, November 29

INSTITUTION OF MECHANICAL ENGINEERS (joint meeting with the ROYAL AERONAUTICAL SOCIETY, at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. T. M. Green and Mr. J. E. Wallington: "Aircraft Propulsion".

MANCHESTER STATISTICAL SOCIETY, INDUSTRIAL GROUP (at the College of Technology, Manchester), at 6.30 p.m.—Dr. O. L. Davies: "An Application of Statistics in Chemical Research".

SOCIETY OF DYERS AND COLOURISTS, SCOTTISH SECTION (at St. Enoch Hotel, Glasgow), at 7 p.m.—Mr. J. Starkie: "The Stripping of Dyed Textiles by the Use of the Hydrosulphite Compounds".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Capt. H. L. Hitchins: "Compasses—Past, Present and Future".

Saturday, November 30

INSTITUTION OF CHEMICAL ENGINEERS, NORTH-WESTERN BRANCH (in Reynolds Hall, College of Technology, Manchester), at 3 p.m.—Mr. K. A. Sherwin: "Concentration of Caustic Soda Solution".

APPOINTMENTS VACANT

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

HEAD OF THE DEPARTMENT OF APPLIED SCIENCE AND ELECTRO-TECHNICS, a HEAD OF THE MATHEMATICS DEPARTMENT, SENIOR LECTURERS and LECTURERS IN SCIENCE (Physics, Chemistry, Engineering), and SENIOR LECTURERS and LECTURERS IN MATHEMATICS, at the Royal Military Academy, Sandhurst—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 1677 (November 28).

PRINCIPAL RESEARCH OFFICER in the National Bureau for Personnel Research, Pretoria, to undertake personnel research in industry—The Scientific Liaison Officer, South Africa House, Trafalgar Square, London, W.C.2 (November 30).

LECTURER IN CHEMICAL ENGINEERING—The Registrar, Loughborough College, Loughborough, Leics. (November 30).

BIOCHEMIST for a research appointment in the Courtauld Institute to investigate enzymes and tissue metabolism in relation to cancer—The Secretary, Courtauld Institute of Biochemistry, Middlesex Hospital Medical School, London, W.1 (November 30).

LECTURER (woman graduate) IN CHEMISTRY to agricultural and horticultural students—The Principal, Studley College, Studley, Warwickshire (November 30).

LECTURER OR ASSISTANT LECTURER IN GEOGRAPHY—The Registrar, University College, Southampton (November 30).

SENIOR ASSISTANT TEACHER IN THE MECHANICAL ENGINEERING DEPARTMENT OF THE South-East London Technical Institute, Lewisham Way, London, S.E.4—The Education Officer (T.1), County Hall, London, S.E.1 (November 30).

ASSISTANT AGRICULTURAL ECONOMIST on the Technical Staff of the Provincial Agricultural Economics Service, and a LECTURER AND RESEARCH ASSISTANT IN FARM ECONOMICS in the Department of Agriculture—The Registrar, King's College, Newcastle-upon-Tyne (November 30).

DEPUTY DIRECTOR, an AGRICULTURAL CHEMIST, a PLANT PATHOLOGIST, an AGRICULTURAL ENGINEER, and an ASSOCIATE PROFESSOR OF ENTOMOLOGY, in the Punjab Agricultural Service (Class I)—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2, quoting Ref. No. 258/284 (November 30).

LABORATORY TECHNICIAN IN THE DEPARTMENT OF PHYSIOLOGY—The Registrar, The University, Liverpool (November 30).

ASSISTANT for research in connexion with the nutrition and metabolism of ruminants—The Secretary, Hannah Dairy Research Institute, Kirkhill, Ayr (November 30).

SPEECH THERAPIST—The County Medical Officer, County Offices, Lincoln (November 30).

LECTURER IN CHEMISTRY—The Clerk to the Governors, South-East Essex Technical College, Longbridge Road, Dagenham, Essex (December 2).

SENIOR ASSISTANT (with good Honours Degree in Physics or Chemistry) for day and evening Science and Telecommunication Classes (senior)—The Education Officer (T.1), County Hall, London, S.E.1 (December 3).

TEACHERS OF (a) CIVIL AND MECHANICAL ENGINEERING, (b) MATHEMATICS AND PHYSICS, at the South-East London Technical Institute, Lewisham Way, London, S.E.4—The Education Officer (T.1), County Hall, London, S.E.1 (December 5).

LECTURER IN DAIRY FARMING at Massey Agricultural College, Palmerston North, New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (December 5).

LECTURER IN ANATOMY—The Registrar, The University, Manchester (December 9).

FELLOWSHIP IN MATHEMATICS, which will be held jointly with a Lectureship at Trinity College—The College Secretary, Balliol College, Oxford (December 9).

LECTURER IN PHYSICAL CHEMISTRY—The Registrar, University College, Leicester (December 9).

LECTURER IN ENTOMOLOGY, and a DEMONSTRATOR IN ENTOMOLOGY—The Secretary, Imperial College of Science and Technology, South Kensington, London, S.W.7 (December 9).

LECTURER to work in the Cancer Research Department of the School of Medicine on the effects of X-rays on tissues—The Registrar, The University, Leeds 2 (December 11).

ASSISTANT LECTURERS IN (a) PURE MATHEMATICS, (b) PHYSICS, (c) ORGANIC CHEMISTRY, (d) PHYSICAL CHEMISTRY—The Registrar, University College, Cathays Park, Cardiff (December 15).

LECTURER (Grade IIa or IIb) in the DEPARTMENT OF BREWING AND INDUSTRIAL FERMENTATION—The Secretary, The University, Edmund Street, Birmingham 3 (December 21).

PHYSICIST—The House Governor and Secretary, Royal Infirmary, Leicester (December 23).

DIRECTOR OF CANCER RESEARCH in the Medical School of the University of Otago, Dunedin, New Zealand—The General Secretary, B.E.C.C. Society, 11 Grosvenor Crescent, London, S.W.1 (Dunedin, December 31).

ASSISTANT ANALYTICAL CHEMIST (male) in the Government Analyst's Laboratory in Salisbury, Southern Rhodesia—The Secretary, Office of the High Commissioner for Southern Rhodesia, 429 Strand, London, W.C.2 (December 31).

Other Countries

ARCHITECTURAL EDITOR, and an INVESTIGATING OFFICER—The Secretary, Royal Commission on Ancient Monuments (Scotland), 14 Queen Street, Edinburgh 2 (January 2).

POSTS in the Imperial Agricultural Bureaux of Soil Science, of Dairy Science, of Horticulture and Plantation Crops, and of Pastures and Forage Crops (including Field Crops)—The Secretary, Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1 (March 1).

DIRECTOR in the Imperial Agricultural Bureaux of Animal Breeding and Genetics, and of Forestry—The Secretary, Imperial Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1 (March 1).

SENIOR LECTURERS at the Natal University College in MATHEMATICS (STATISTICS) in Durban, in CHEMISTRY in Pietermaritzburg—The Secretary, Universities Bureau of the British Empire, 24 Gordon Square, London, W.C.1.

ASSISTANT AGRICULTURAL ECONOMIST, and an INVESTIGATING OFFICER—The Registrar, The University, Bristol 8.

LECTURER IN PHYSICS—The Registrar, Municipal College, Portsmouth.

PHYSICAL CHEMIST for work in connexion with Steelmaking Slags, and Refractories—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, endorsed 'Chemistry Department'.

LECTURER IN CHEMISTRY—The Clerk, Northern Polytechnic, Holloway, London, N.7.

RESEARCH CHEMIST in connexion with the study of problems of fruit and vegetable preservation—The Director, Research Station, Campden, Glos.

RESEARCH ASSISTANT—The Secretaries, National Federation of Dyers and Cleaners, 7 Laurence Pountney Hill, Cannon Street, London, E.C.4.

ASSISTANT LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT—The Head of the Electrical Engineering Department, City and Guilds College, Exhibition Road, London, S.W.7.

LABORATORY ASSISTANT (Grade I) in the DEPARTMENT OF PHYSIOLOGY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1.

RESEARCH SUPERINTENDENT, and an INFORMATION OFFICER—The Director of Research, Printing and Allied Trades Research Association, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

PHYSICIST with experience in electronic instruments or electronic circuits, a PHYSICIST or ENGINEER with experience in electrical (non-electronic) or magnetic instruments, and JUNIOR PHYSICISTS or ENGINEERS with experience in electrical or electronic instrument technology—The Director of Research and Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.1.

RESEARCH ASSISTANT to the Wheatstone Professor of Physics, to take part in biophysics research—The Secretary, King's College, Strand, London, W.C.2.

LABORATORY ASSISTANT for the Official Seed Testing Station—The Secretary, National Institute of Agricultural Botany, Huntington Road, Cambridge.

LECTURER IN PHYSICS (with subsidiary Mathematics), and a LECTURER IN MATHEMATICS (with subsidiary Physics)—The Registrar, Merchant Venturers' Technical College, Unify Street, Bristol 1.

LECTURERS (2) in either MECHANICAL or ELECTRICAL ENGINEERING at the Bournemouth Municipal College—The Education Officer, Town Hall, Bournemouth.

LECTURER IN CHEMISTRY—The Principal, Kingston-upon-Thames Technical College, Kingston Hall Road, Kingston-upon-Thames, Surrey.

Bernice P. Bishop Museum. Occasional Papers. Vol. 18, No. 6: Notes on Samoan Elaterid Beetles, with Descriptions of Two New Species. By R. H. Van Zwaluwenburg. Pp. 95-102. Vol. 18, No. 7: Aquatic Coleoptera of Oceania (Dytiscidae, Gyrinidae and Palpicornia). By J. Balfour-Browne. Pp. 103-132. Vol. 18, No. 8: New Species of Succinea from Tahiti, with Remarks on other Polynesian Species. By C. Montague Cooke, Jr., and William J. Clench. Pp. 133-138. Vol. 18, No. 9: Two New Storeurs from the Philippines (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 139-144. Vol. 18, No. 10: The Genus *Liaqora* (Rhodophyceae) in Hawaii. By Isabella Aiona Abbott. Pp. 145-170. (Honolulu: Bernice P. Bishop Museum, 1945.) [174]

Famine, Rationing and Food Policy in Cochín. By K. G. Sivasswamy; and Medical Surveys, by Lieut.-Colonel T. S. Shastry. Pp. x + 77 + 35 + 8 plates. (Royapettah, Madras: Servindia Kerala Relief Centre, 1946.) 3 rupees. [234]

Report on General Survey of British Somaliland, 1944. (Colonial Development and Welfare Act, Economic Survey and Reconnaissance.) Published under the authority of the Military Government, Somaliland Protectorate. Pp. 12 + 17 charts. (Buraq: Government Press, 1945.) 3s. 6d. [234]

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Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 20, 1938. Pp. 273 + vii. Vol. 21, 1939. Pp. 380 + vi. Vol. 22, 1940. Pp. 278 + vii. Vol. 23, 1941. Pp. 285 + vii. Vol. 24, 1942. Pp. 391 + x. Vol. 25, 1943. Pp. 443 + xii. (Rochester, N.Y.: Eastman Kodak Co., 1939-1943.) [254]

Transactions of the San Diego Society of Natural History. Vol. 10, No. 17: The Glossy Snake, Arizona, with Descriptions of New Sub-species. By Laurence M. Klauber. Pp. 311-398 + plates 7-8. Vol. 10, No. 18: Data and Field Notes on the Desert Tortoise. By Chapman Grant. Pp. 399-402. (San Diego, Calif.: San Diego Society of Natural History, 1946.) [294]

Report of the Kodaikanal Observatory for the Year 1941. Pp. 4. (Delhi: Manager of Publications, 1942.) 3 annas; 4d. [294]

An Arithmetical Approach to Ordinary Fourier Series. By Aurel Winter. Pp. 29. (Baltimore, Md.: The Author, Rowland Hall, Charles and 34th Streets, 1945.) 1.20 dollars. [294]

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Records of the Department of Mineralogy, Ceylon. Professional Paper No. 2: Ilmenite, Monazite and Zircon (Sessional Paper 6 of 1926, revised); Gems and Semi-Precious Stones of Ceylon. By D. N. Wadia and L. J. D. Fernando. Pp. 44 + 4 plates. (Colombo: Ceylon Government Press, 1945.) [294]

Carnegie Institution of Washington: Department of Terrestrial Magnetism. Scientific Results of Cruise VII of the *Carnegie* during 1928-1929 under Command of Capt. J. P. Ault. Oceanography—4: The Work of the *Carnegie* and Suggestions for Future Scientific Cruises. (Publication 571.) Pp. vii + 111. (Washington, D.C.: Carnegie Institution, 1946.) 1.50 dollars. [294]

Annual Report of the Agricultural Meteorology Section, Indian Meteorological Department, for the Year 1944-45. Pp. iii + 54. (Poona: Indian Meteorological Department, 1946.) [294]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 189: Soils of the Berriquin Irrigation District, N.S.W. By Robert Smith. Pp. 55. (Melbourne: Government Printer, 1945.) [294]

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(not included in the monthly Books Supplement)

Great Britain and Ireland

The Science of Relationships. Report of a Rural Life Conference held at Downe House, Newbury, January 8-11, 1946. Pp. 72. (London: Rural Life Conference, C. M. House, 6 Salisbury Square, 1946.) 2s. [235]

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(Continued from page iii of Supplement)

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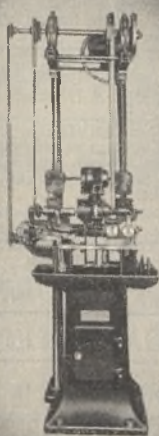
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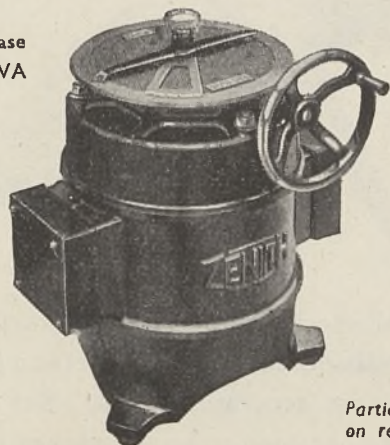
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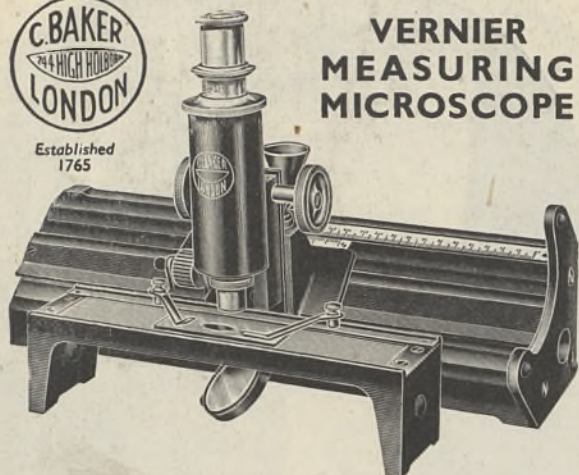
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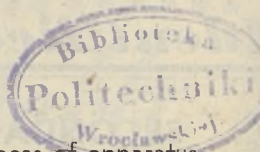


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