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SCIENCE AND HUMANITY

ANY doubts as to the value of the Conference on "The Place of Science and Industry", arranged by the British Association in January 12 and 13, should have been removed by Lord Woolton's well-deserved tribute to the way in which the educational work of the Association in the field of nutrition, carried out over the ten years following Sir F. Gowland Hopkins' presidential address at Leicester in 1933, had prepared the public mind for the food policy which averted the threat of definite food shortage in Britain soon after Lord Woolton took office in April 1940. People had come to realize that nutrition, far from being a fad, was the plainest of common sense. A nutrition policy which aimed at distributing food on the basis of its nutritional value, not its capacity to satisfy appetite, so that the vulnerable classes—mothers, expectant mothers, infants and children and heavy workers—should have full protection, and the rest of the population should have a physiologically adequate diet, had met with the approval and support of the public. Further, such a policy is in a fair way to become a permanent part of the food policy of Britain. The immense benefit to the nation's health and the actual raising of the pre-war standard even under stress of war have already been generally recognized, and if other speakers besides Lord Woolton dwelt on the point, it was rather to stress the folly of lightly abandoning such a solid advance, and to indicate the immensely greater possibilities which the further extension of scientific research in this and in related fields and its application in practice and policy hold for the future.

What is true in this important field of food and nutrition is true in other fields. The effective application of science to social and industrial affairs involves the understanding and support of the general public. In discussing scientific and industrial research in these columns last autumn (cf. *Nature*, **154**, 407 ; 1944), it was pointed out that the expansion of such research to the scale required involves a clear and widespread public understanding of its purposes and implications. It is as a contribution to the task of public education that the Conference is important, and both Sir Richard Gregory and Sir Harold Hartley were at pains to stress this point. The Conference was not just another in the long series of debates, discussions and reports on this subject in the last two or three years : it was a step to further public education, on which the expansion of research depends.

Even such a brief account of its proceedings as is printed in the present issue of *Nature* (p. 96) gives some idea of the justice with which it can be claimed that the Conference has helped to prepare the public mind for what is involved in the expansion of scientific and industrial research to the scale imperative for an adequate attack on post-war problems. When the full report of the Conference is published, it will provide scientific workers generally with much material to assist in the task of educating the public. The Association can rarely have assembled an array of speakers so imaginatively alive to the issues, so able in exposition and in interpretation and, it may

be remarked, so clear in delivery. Even the more commonplace papers showed no lack of honest workmanship, and should be equally useful in the task of further public education.

The papers which touched on food and nutrition illustrated two further characteristics of the Conference: the dynamic character of the relations between science and industry; and the strong emphasis on the social factors, both in the prosecution of research and in the application of its results. The continued reaction of science on industry and of industry on science, the way in which industry stimulates science as well as science industry, or in which one industry stimulates another, was apparent in one field after another. Whereas Dr. W. T. Astbury linked the textile industries with the advance of biology and the plastics industry, Prof. J. M. Mackintosh summoned not merely the biologist and the chemist but also the mechanical expert and the plastics industry to the help of the surgeon.

The Conference thus provided a powerful demonstration that we cannot wisely tolerate stagnation in any field of industry, and that we must seek to promote advance along the whole industrial and scientific front so as to maintain a proper balance. But there must also be a fuller measure of co-operation and a further attempt to integrate knowledge both in the scientific and technical field. Here again it was urged that we should learn the lessons of the war years and apply them to the tasks of peace, and Sir Lawrence Bragg uttered a wise warning against mistaking the means for the end. The material achievements which science makes possible—rapid communication and travel, power and command over materials—are making the world a higher type of organism with a more complex nervous system and greater division of function. But the material and technical achievements must be seen against the cultural and moral background, so that we can diffuse that wide understanding of science which is the best safeguard against its misuse, and the surest inspiration to the service of society.

That idea, never entirely absent, came most insistently to the front in the final session. The importance of the social motive as a stimulus to research explicitly stressed by Mr. E. Carter was implicit in all the other papers, though in Sir Lawrence Bragg's the emphasis was rather on its value in attracting to industry men of the highest calibre. There was general agreement as to the shortage of men of the highest capacity for the main fields of research to be pursued, and while there was some uncertainty as to how far Sir Lawrence Bragg was right in this particular contention, the changed outlook, the emphasis on serving the needs of the consumer rather than on the profit motive, and the recent developments of economic science, all trend in the right direction of increasing the attractiveness of a scientific career in industry, on the importance of which, from different points of view, so much stress was laid throughout the Conference. With all the emphasis on industrial efficiency, this was viewed against the right background and interpreted in no narrow financial or mechanical sense, but as covering the social efficiency also—the extent to which an industry can serve the needs both of the workers it employs and of the community, industrial or social, the wants of which it is its prime purpose to supply.

Here as elsewhere there was vision and imagination. The Conference was undoubtedly a step to supply that publicity for which such reports as that of the London Chamber of Commerce last year so insistently called—the stimulation of public interest in scientific work and the interpretation to the public of the results of that work in industry. Certainly it demonstrated that we have the capacity to combine science with practice in industrial development, and that increased contacts will ensure the advancement of both. But more than this, the Conference was of importance in the field of public relations. The dynamic picture of the relations between science and industry unfolded in its sessions, the imaginative glimpse of the possibilities before us in the post-war world if we harness aright knowledge and power, cannot but make for closer understanding between the parties concerned, whether management and labour, the industrialist, the Government administrator, the scientific worker in the university or in industry, the producer and the consumer. Above all, it is a great challenge to the scientific worker himself, in whatever branch of science, pure or applied, he may be engaged, to explore more fully, more patiently, more resolutely and imaginatively those many fields where knowledge is still lacking; not least where new knowledge and creative thought may contribute most swiftly and significantly to the evolution of the new forms of organization which may be required to serve the needs of to-morrow, and to place freely and fully at the disposal of all the rich resources and wide powers which science is giving us to command, while safeguarding the freedom and culture which are our most precious inheritance.

HUMAN SEX HORMONES

The Hormones in Human Reproduction

By George W. Corner. Pp. xix+265+24 plates. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1942.) 18*s*. 6*d*. net.

BIOLOGY teachers are soon going to be confronted with the problem of bringing up to date text-books on a number of subjects, particularly those which have not previously been well presented to the student. Curiously enough, there are few works which provide an authoritative introductory account of the factors underlying human reproductive processes. This is partly because the interval between the War of 1914–18 and the present War was one of very active research, in which most people with first-hand knowledge of the subject were too absorbed in experimental work to turn to the task of summarizing the progress which research was making. Prof. Corner's book on the hormones in human reproduction is therefore most timely, for it is at once a concise and a comprehensive exposition of the subject, given by one of the foremost contributors to knowledge in this field of physiology. The book was published in the United States in 1942, but, as relatively little new has since emerged in this line of research, it provides as up-to-date a general treatment of the subject as

could now be desired, and in so doing fills a very real gap.

The book is, however, much more than a useful text-book. It is a fascinating story which will also prove of interest and value to the lay reader. Here again it answers a long-felt need for a simple but accurate outline of the processes of reproduction, presented in a form which is both intelligible and attractive to the non-scientific public. This in fact, as Prof. Corner tells us in his introduction, was his main purpose in writing the volume, which was built up round the Vanuxem Lectures he gave at Princeton in February 1942—lectures intended not for specialists but for a mixed university audience. His aim has been brilliantly realized, for the book is all that can be asked of a general presentation of a complicated subject. It is brief; it eliminates unessentials; it carries the reader gradually into each topic by showing what the problems were that had to be solved at each step; and, over and above all, its style is not that of a scientific treatise but of a literary work. The romance of discovery is colourfully illustrated, particularly in the chapter which deals with the progestational hormone, a field of inquiry which will always be associated with Corner's name. It also indicates the established limit of knowledge by showing where present researches promise to break new ground.

The volume opens with a general statement about sexual and asexual reproduction in the animal world. The second chapter considers the human egg, and the organs that make and care for it. The third deals with the periodicity of ovarian activity, and discusses variations in the sexual cycle in mammals. The chapter which follows is a fascinating account of the discovery of the œstrogenic hormones, and of their action. Chapter 5 deals with the hormone of the corpus luteum, which is responsible for the uterine changes that permit the implantation of the fertilized ovum. In this chapter Corner gives a most lively résumé of the part he played in the story, and of the difficulties which had to be overcome. However disheartening it may have been at the time, one can now appreciate the lighter side of the episode he relates—how he was racing up the steps of his laboratory at Rochester, carrying a glass syringe which contained the world's entire supply of crude progesterone, when he stumbled and fell, and lost it all. The chapter which follows deals with the endocrine control of the menstrual cycle, and gives a very balanced statement of this difficult question. Next follows a chapter on endocrine arithmetic, which presents some novel calculations about the amount of sex hormones produced daily in the body; then a chapter on the hormones of pregnancy, and finally one on male hormones. The brevity of Corner's account of the male side of reproduction is perhaps the only feature which one can regret in the book. Each chapter considers the clinical applications of the sex hormones, and each is excellently illustrated.

While, as Prof. Corner tells us, the volume was written primarily for the layman, it is certain that it will also be widely used by the student as an introduction to a growing branch of knowledge. Quite apart from the function which it is likely to serve in this way, it will undoubtedly, because of its delightful presentation, attract to the subject new research workers, who will discover from it at least as many problems to engage their attention as those which he has so admirably elucidated.

S. ZUCKERMAN.

SEX EDUCATION AND GUIDANCE

Sex Education

A Guide for Parents, Teachers and Youth Leaders. By Cyril Bibby. Pp. xi+291. (London: Macmillan and Co., Ltd., 1944.) 7*s*. 6*d*. net.

HOW thorny the question of sex is to the adult mind is aptly symbolized by the myth of the gooseberry bush; and the consequences of the conspiracy of silence are seen by doctor and psychiatrist. It is, however, a truism of practice that none but serious cases come for treatment, and much daily friction and maladjustment arising from unresolved sex conflicts does not reach the consulting room. Few indeed are the adults who cannot recall from their own adolescence periods of intense psychic pain which greater enlightenment might have spared them; more fail to achieve harmony in marriage and that liberation of energy which comes of an unclouded mind, not because they were born abnormal, or because adjustment to modern conditions is impossible, but because, at critical periods of psychic development, they lacked the right emotional attitude towards manifestations of their own sexuality.

As yet, we have not had a generation of parents in whose outlook sex problems and interests take as natural and unexaggerated a place as questions of dietetics or physical exercise. We cannot, therefore, say that a sound sex education will be a panacea for the mental ills of society. Indeed, experience with the neuroses of the War of 1914–18 has shown that conflict between *any* innate instinctive impulse and the environment may bring about neurotic dysfunction. With confidence, however, we can assert that a system of education which strips sex of the shameful glamour which decorates walls with obscene epigraphy, and presents it as something natural and healthy like breathing, eating and sleeping, will diminish tension and conflict and contribute to happiness and efficiency. That this is very largely now an accepted thesis among educationists and even among the majority of laymen represents a broad advance of great moral and ethical significance.

It remains for the educationist to meet the practical difficulties of applying the principle. Mr. Bibby's book is an attempt to do this in a comprehensive way. Recognizing that sexuality is coterminous with life itself and pervasive of all aspects of the personality, he does not rest content with mere training. His suggestions cover the whole education of the child, the youth, the adolescent and the young adult. For him, sex education is a preparation for life itself, not a matter only for the biology lesson or an allusive discussion of the pollination of flowers. A beginning should be made in the nursery, not alone on the basis of imparted facts—though these are important—but in the creation, by parental precept and attitude, of a right outlook. The school-child should already have received an emotional and factual education on this topic on which the teacher can build with confidence his more specific training. Literature, religion, geography, history and even mathematics—all subjects of the curriculum—can then be laid under contribution in the building up of a generation emancipated from dark mystery and happy in a deeply ingrained habit of control.

This, Mr. Bibby recognizes, is an ideal, though not perhaps too remote. Few, as yet, have the necessary knowledge or the fundamentally sound emotional attitude necessary for the instruction of their children in the earliest stages of life. At present, therefore,

the task devolves largely upon the teacher and youth club leader. His book is a guide for bridging the transition period between the present and a future of fully enlightened parents. How practical it is can be seen by the appendixes, which contain specimen lecture material, suggestions for concrete activities and a tentative but comprehensive scheme for sex education throughout the whole early period to full maturity and parenthood. The body of the book contains sound advice, documented by references to research, and illuminated with well-chosen examples of questions put by children, adolescents and adults. Particularly valuable to the parent is Chapter 3, which swiftly and effectively deals with the major problems of sex as they arise in the home and which may well clear away cobwebs in the adult mind. The discussion which follows, of the place of sex education in the school curriculum and the kind of teaching appropriate to the various stages of development, is based upon unimpeachable psychological and educational principles. Chapter 6, which gives a brief outline of the changes, intellectual, emotional and physical, of adolescence will have special significance for youth leaders and all who have to do with boys and girls in that most critical of all phases.

The book is comprehensive in scope and framed to meet the needs of the intelligent but not specially instructed reader. This, however, does not mean that it is either superficial or elementary. Indeed, it might well be recommended as a text-book on the educational aspects of sexology. The bibliography will introduce the interested reader to literature of more specialized kinds, and the author's brief comments on the books he recommends will be found of the greatest value. It is a pity that an index is not provided, for, although the author seeks to justify the omission in his introduction with the plea that his subject must not be viewed piecemeal, this reviewer feels that a speedy reference to particular passages would be of value to the busy teacher, the more so since many topics are dealt with in their several aspects in different parts of the book. An index would serve to bring together all that the writer has to say on any important aspect of his subject. A further point concerns the vexed question of acknowledging the source of quotations and references. Mr. Bibby has obviously drawn extensively upon the work of others: lengthy footnotes are out of place in a book like this; but it would be helpful to the reader who wishes to pursue the subject, if sources and page references were given.

These, however, are small criticisms of a book so sane and moderate in its outlook, so much needed at the present time, and so calculated to further both the general cause of education and the more specific purpose of spreading enlightenment and banishing prejudice. W. D. W.

THE SPIDER'S WEB

La toile géométrique des araignées

Par André Tilquin. Pp. 536+8 plates. (Paris: Les Presses universitaires de France, 1942.) 150 francs.

IN this work Dr. A. Tilquin sets out the results of six years research on the making of the familiar orb-webs spun by spiders of the family Argiopidæ, and it may be said at once that the book is well worth the attention of all, whether arachnologists or not, who are interested in the study of instinctive behaviour.

The author begins by clearing away any psychical factors. He finds it impossible to detect any evidence of mental relationship between a man and a spider of the kind which is common between a man and his dog. Whereas to the dog his master seems to appear as an individual, to the spider a man represents no more than a source of shade or warmth, so that in all its life the spider never shows more recognition of man than is expressed in an inhibition of the reflex dropping from its web at his approach. Clearly, therefore, a mechanistic description of web-making is to be expected throughout.

The difficulty of getting Argiopidæ to make normal webs in captivity has been overcome by providing each spider with an isolated wooden framework, to which the web is fixed. An Argiopid spider, it is clear, must have sufficient space for its operations, which cannot be reduced to a smaller scale, and Dr. Tilquin has devoted two rooms in his house to their accommodation. More than a dozen species have been kept under observation, but most of the work has been done with *Argiope brünnichi*.

Two chapters are occupied by a description of the web, an accurate analysis of its constituent parts and their variation among different species; for the author observes that a minute study of web-structure, made independently of the actions of the spinner, is the best introduction to the study of these activities themselves. It clarifies the problems set and points the way to their solution.

Chapter 3 is chiefly a consideration of experiments on the influence of light and gravity in determining the direction of the *fil suspenseur*, or the strong cable from which the web hangs and which forms the upper limit of the whole field of operations. The next two chapters deal with the construction and spacing of the radii. A new conception is introduced here, namely, that solid and stable points of support exert an attraction for the spider, whereas unsteady flexible ones are less attractive or even repellent. This determines the distance of the hub of the web from the *fil suspenseur*, and so affects the area and symmetry of the circular portion. It also influences the angles between the radii, so that often these angles have different values above and below an approximately horizontal middle line. These chapters expound Dr. Tilquin's concept of the web as a *champ dynamique*, an area in which forces of attraction and repulsion are at play, and the spider is moved into equilibrium with their resultants.

The next three chapters apply this hypothesis or concept to the laying down of the temporary spiral, its removal and replacement by the viscid spiral. The effects of age, sex, moulting, mating and egg-laying are included, and form one of the most original portions of the monograph. A chapter follows on the special features peculiar to the webs of a single genus or species, and the tenth chapter is a general summary. It is characteristic of Dr. Tilquin's methods that he here introduces the term *sériciphilie* to describe a spider's apparent preference for touching silk rather than anything else: for example, the spider's 'foot', placed on the thread which leads from the hub of the web to its hiding-place, is exhibiting *sériciphilie*, rather than awaiting the occurrence of vibrations.

Dr. Tilquin, writing of these and other matters with an almost excessive attention to detail, has made an advance on the researches of Peters and of Wiehle, both of whose theories he criticizes; and he has made a notable contribution to our understanding of an object which is unique among the products of animal industry. T. H. SAVORY.

Building Illustrated

Being an Introduction to Standard Building Methods. By W. H. Smith. Pp. viii+112. (London: E. and F. N. Spon, Ltd., 1944.) 16*s*. 6*d*.

THE value of the attractive paper cover on this book has been made useless by the numerous mistakes which appear on it. For example, and here I quote from a copy of by-laws with respect to new streets and buildings: "Each external wall shall be provided with an effective damp proof course at a height of not less than six inches above the surface of the adjoining ground". The damp proof course shown on the paper cover is just over three inches above the ground-level.

The orthographic drawings have not been made in accordance with the British Standard Specification Drawing Office Practice. To give examples, the sections of Figs. 29, 82 and 86 want turning over so as to be in correct projection, and plain lines should have been used for all measurement lines instead of broken lines as shown throughout the book.

Now a word or two about windows. The pulley stile in detail *A*, Fig. 83, wants turning over so that a proper tongued and grooved joint is made.

The freakish *S* which pervades the drawings should be avoided by students when printing the titles, as this is more often mistaken for an *F*.

There are two particularly good chapters; one is on drainage and the other on defects found in buildings. A. S. EMERY.

An Introduction to Philosophy

By W. A. Sinclair. Pp. 152. (London, New York and Toronto: Oxford University Press, 1944.) 5*s*. net.

THIS clear and well-reasoned introduction starts from the classical problem of modern philosophical thought—sense perception and the knowledge we take to be based upon it. For the scientifically trained reader this is probably the best approach, though not necessarily for other readers. By his method of treating the subject Mr. Sinclair challenges comparison with Russell's well-known "Problems of Philosophy" and survives the test very well. He scarcely has the lightness of touch of his predecessor, but he is rather more systematic and is better at indicating further possibilities and other inquiries. The footnote references to important thinkers are well done. The advice for further reading is refreshingly unconventional, but not well balanced: and what is said about Plato and Greek philosophy is definitely misleading. A. D. R.

Proceedings of a Conference on Problems in the Utilisation of Small Coals

Held at the Institution of Civil Engineers, November 10th and 11th, 1943. Pp. 294. (London: British Coal Utilisation Research Association, 1944.)

IT is inevitable that incombustible matter accompanies coal arriving at the pithead and in varying degrees of association, depending on the quality of the seam. From this point follows a series of cleaning processes—dry and wet—which in general aim at the removal of dirt and fine coal. Water is usually necessary, and as a consequence the colliery must dispose of the unwanted residue of the cleaning process which contains an undesirable proportion of water. This residue, commonly known as 'slurry', consists of coal which contains too much incombustible matter, too much water and at the same time is too fine in size to have commercial value. This combination of physical conditions imposes such difficulties that remedial measures to convert 'slurry' into salable fuel are in normal times unremunerative; but this is only a relative term, for the quantity of this waste of potential value is enormous—many millions of tons—which in times of scarcity is actually used. It may be that the days when this fuel can be so lightly discarded as hitherto have already passed for ever. It must be recognized that the mining industry has in the past given much attention to the problem, as will be evident from the present report on the conference on the utilization of small coals, at which twenty-eight papers were presented. These give a measure of work done, while a visit to the surface workings of a colliery will reveal the scope of the task of disposing of the wet, dirty fine coal which is produced. There is another if somewhat different problem in the disposal of fine coke.

H. J. HODSMAN.

A Handlist of News Pamphlets, 1590-1610

By Dr. D. C. Collins. Pp. xx+129. (London: South-West Essex Technical College, Walthamstow, 1943.) 10*s*. 6*d*.

THIS admirably produced little volume is in two parts: first, a handlist of news pamphlets printed between 1590 and 1610 and still extant; and secondly, a list of such pamphlets printed between 1590 and 1610 and entered in the Stationers' Register, but not now extant. The first list is annotated, the contents being indicated where the title is insufficient, and the comments show the significance of the item. The list is arranged chronologically, and within each year according to the date of entry in the Stationers' Register. Surviving pamphlets not entered in the Register follow the last entered copy surviving for each year. Where more than one copy of the pamphlet survives, the British Museum copy has normally been used. Other copies used are indicated by a reference letter; but the names of libraries possessing a single unique copy are given in full. If the copy for the transcript is one not recorded in the Short Title Catalogue, the press mark of the library is given. Both the Short Title Catalogue number and the date of entry of the pamphlet in the Stationers' Register and the high standard of bibliographical detail should make the list the more valuable and welcome for research into the collection and dissemination of news during the period covered. Its value and purpose in this respect are concisely explained in Dr. Collins' excellent introduction.

Get to Know Yourself

A Series of Psychological Tests. By Joseph Ralph. Pp. iv+89. (London: Chaterson, Ltd., n.d.) 3*s*. 6*d*. net.

APART from the suggestion in the title that more self-knowledge is desirable and a few sensible remarks here and there, this book has little to commend it. The author sets out a series of so-called self-rating 'tests' of nineteen 'dispositions'. Numerical weights, determined presumably by the author's inner consciousness, are attached to each test item. Norms suggested have an equally subjective quality. The term 'test' is certainly a misnomer for a set of overlapping and equivocal questions unstandardized or scaled in any way. The alleged 'dispositions' are nothing more than a mixed series of popular catch-phrases. No substantiation is given of the claims on behalf of the tests in the prefatory note. J. C.

THE PLACE OF SCIENCE IN INDUSTRY

AS was stressed by Sir Richard Gregory in his introductory address, and again by Sir Harold Hartley in summing up at the final session, the two-day conference on "The Place of Science in Industry", arranged by the Division for the Social and International Relations of Science of the British Association on January 12 and 13, and held at the Royal Institution, was no mere repetition of discussions on scientific and industrial research, or the relations of science and industry to be found in numerous recent reports. It could not be claimed that fresh ideas in regard to the strategy and tactics of research or its organization were ventilated at the Conference, though some of the war-time achievements of science were disclosed for the first time to a wider circle. The subject was viewed essentially in its social setting, and the Conference was a definite attempt to further that task of public education upon which the adequate support of research depends. Unless there is general understanding of the achievements and the possibilities of scientific research, we cannot expect that there will be forthcoming the public support, either of finance or of men, on which the expansion of our scientific effort to meet the post-war demands and opportunities ultimately depends.

As Sir Harold Hartley pointed out, the Conference had two main objects: to give the public a detailed idea of the contributions of science in industry, and to give a clearer view of what should be our strategy and tactics in this field. Its organization was thus in harmony with the educational work of the British Association in the field of nutrition to which, at the final session, Lord Woolton paid such a generous and emphatic tribute. If a tribute no less emphatic and generous should be paid to the Association by some future Minister of Production for its work in this field in promoting general interest and understanding of the place and application of science in industry, it may well be for the balanced and lucid presentation of the subject which characterized the recent Conference. Sir Richard Gregory dealt with some of the popular misconceptions of the past and referred to the impossibility of a sharp separation between research workers in pure and in applied science, or again of separating scientific workers from other citizens in their social duties and responsibilities. He urged that there must be a two-way traffic between science and industry if we are to be in the van of progressive life and service. Advances on this united front would raise standards of living and strengthen the social structure if they are correlated with humanistic national policy. Public opinion would not now tolerate the deplorable social effects of the introduction of new powers and processes of a century or more ago.

Referring even more emphatically than Sir Richard Gregory to the lag between scientific knowledge and social wisdom, Mr. Ernest Bevin, who presided over the first session, on "What Industry Owes to Science", commented on the greater receptivity of industry to scientific ideas in war-time than in time of peace. The time lag, he believes, is due partly to faults in the management or directorate in industry, and partly to traditions of the past. He urged closer study of the problem of how best to bring the benefits of scientific discovery into the lives of the people so that they can be enjoyed by the masses as quickly as possible and at a price within their reach. The people should, as it were, have a vested interest in a scientific discovery.

Following on Mr. Bevin's plea for social and economic research—and it was notable that the Conference was never allowed to forget such aspects—the session considered some of the industrial achievements of science in a way which should win the support of any trade unionists who tend to look askance at science. Lord Brabazon's dry humour played delicately over the achievements of aviation, emphasizing the immense potentialities opened up by jet propulsion with its gas engine, revolutionizing aeroplane design and speed, with possibilities as power units in other fields. He referred to the important part which the universities must take in such fields, the necessity of full freedom for the fundamental research worker, with no dictation as to the detailed direction of his work. Sir Robert Watson-Watt followed with a paper on telecommunications, in which once again the repercussion on, and stimulation of, other industries by research in a particular industry was stressed. Distinguishing between the internal science and external science with reference to an industry, the former being scientific effort oriented towards the direct solution within the parent technique of the industry of problems peculiar to the industry, Sir Robert said that the telecommunications industry has been exceptional, and exceptionally fortunate, in its utilization of external science. He instanced the demands it has made on the metallurgist for metals, on the inorganic chemist for dielectrics, basic materials and coatings, and glasses which 'wet' the metals used in the vacuum tubes, on the organic chemist for dielectrics for cables, on the crystallographer, the electron physicists, on those expert in classical optics, acoustics, geophysics and solar physics.

Much the same, if less extensive, stimulating interplay between industry and the sciences and between industries was revealed in Dr. W. T. Astbury's paper on synthetic fibres. Dr. Astbury pointed first to the close relations between textiles and biology, and then to their relations with the plastics industry, and to the part played in recent developments by such a tool as X-rays. The reasoned, scientific development of regenerated protein fibres is a direct consequence of X-ray studies carried out in a university. Again, such synthetic fibres are really supplementary to natural fibres and not just substitutes; they increase textile potentialities, and at the present rate of progress and in a sane economic world there is no knowing to what heights science may lead the textile industries. Dr. Astbury strikingly emphasized the indivisibility of science, pointing out that the study of wool and the study of muscle are not easily separated, and Prof. J. D. Bernal, in summing up, said that science and industry are two aspects of one principle: we must find the proper relation between the organization of science and industry, always remembering that it should be a two-way traffic. Whereas in the older industries the process may be mainly one of infiltration of science, in the newer industries the discussions indicated that the most conspicuous feature might be the stimulation of science by industry.

Opening the afternoon session on "Fundamental Research in Relation to Industry", Lord McGowan, who presided, suggested that we should consider as fundamental any research which is primarily directed to increasing our understanding of the causes of phenomena and of the principles and generalizations which make up the so-called 'laws' of Nature. Com-

menting on the development of our knowledge of plant design, he suggested that what is commonly termed the 'safety factor' to allow a sufficient margin of size would be more aptly described as the 'ignorance factor'. Research in the chemical industry can be described as of four types: that directed to maintain and improve the quality of products and economical working; chemical engineering research; that into problems of industries served by chemical industry, such as agriculture; and speculative research, such as that in the high-pressure field, of which polythene has been the outcome. On this Lord McGowan commented that it is difficult to ensure the continuous prosecution of fundamental research in a laboratory where interesting and exciting industrial developments are taking place. The bulk of the fundamental research should be carried on in university laboratories, though some would be carried out in Government laboratories, and Lord McGowan said that Imperial Chemical Industries Ltd. has decided to establish a special laboratory for fundamental research, administratively and geographically separated from works laboratories.

Lord McGowan was followed by a trio of brilliant papers which should effectively dispose of the view once entertained at British Association meetings that engineers have the monopoly of lucid exposition and clear delivery. Prof. P. M. S. Blackett, dealing with physics, urged that research should be directed to cheapening the production of good articles and not simply towards increasing the number of fancy articles, and referred to unfavourable factors in our economic system which require attention. He urged that close relation between pure and applied research is essential and condemned the snobbery which sometimes hinders such contacts. More generous support for fundamental research is required, and he pleaded for more corporate action by scientific bodies such as the Royal Society and professional bodies in reviewing the country's scientific resources, their disposition, and the planning of policy. To do this, staff will be essential and a watch should be kept over the effect of chance discoveries. Our main task is to ensure, first, the application of science in raising the standard of living; the prosecution of science as a cultural or intellectual interest will follow. If Prof. Blackett's observations were general, Prof. E. C. Dodds kept strictly within the field of biochemistry, using the discoveries of penicillin, of insulin and of the synthetic œstrogens to illustrate the immense potentialities of biochemistry for human life, especially in the Middle and Far East, where the repercussions on population problems may be profound. All these discoveries arose in academic laboratories, and the first need is to encourage fundamental research and provide the investigator with every facility to experiment merely for the sake of experimenting.

Dr. C. D. Darlington, in discussing the unity and power of biology, gave a no less fascinating picture of the implications of biology in the field of plant and animal breeding, of the control of diseases of crops, and of such human scourges as cancer. The teaching of biology, he urged, is thirty years out of date, and that will delay the fruition of the unity and power which he described. From what we know of different modes of activity of proteins, common fundamental principles are emerging, which will provide an intellectual and a material power which will make life very different for us all. Dr. D. P. Riley, who followed, in spite of the fact, which he duly noted, that the speakers at the Conference included five eminent in X-ray work, made the mistake of attempting to cover too wide a field in the time, and his enumeration of the many fields of application of X-rays in science and industry was too ill prepared to leave him the opportunity to develop adequately his remarks about the training courses in X-ray work at Cambridge to ameliorate the shortage of X-ray workers, or on the importance of freedom of publication of scientific research both as a stimulus to research and an incentive to the investigator.

The session on the morning of January 13, over which Sir John Greenly presided, was devoted to industrial research and development, and brought some more impressive evidence of British technical achievements and the impact not only of science on industry, but also of one industry on another. Sir John Greenly, confining himself to general observations, reaffirmed his own conviction that science has contributed and will continue to contribute immeasurably to successful industrial enterprise. Quoting from Marcus Aurelius, he urged that to investigate systematically and truly all that came under our observation is exactly what we expect of science in its application to industry. Besides the contribution of new ideas and prospects from fundamental research leading to new inventions, there is, scarcely less important, the continuous help given to the normal conduct of a business by indicating improved methods of production and suggesting the use of new materials. He cited welding as a particularly good illustration of the way in which science has helped to make an industry more efficient and, by providing a new and better technique, assisted in solving the problems of export and full employment. Finally, he stressed the importance of full co-operation and team-work on the part of all concerned, and above all of giving the scientific worker the fullest opportunities in order to enable him to continue to be the pathfinder of industry.

Dr. C. Sykes followed with a review of the general field of metallurgy, in which he pointed out that there is no hard and fast line between research and development. Dr. Sykes emphasized the cost of development work and the dependence of the rate of development on the degree of confidence it establishes between suppliers and users. With regard to post-war development, he foresees four types of problems and needs: the proper allocation of the available technical personnel; the adequate development of schools for research at the universities; the encouragement of enterprise, in which connexion he welcomed the Chancellor of the Exchequer's recent concessions with regard to obsolescence; and the furthering of collaboration between industries. It was natural enough that Dr. S. G. Hooker's account of the development of the Merlin engine and of what those developments have meant in extending the carrying power, climbing power, speed and general performance of aircraft in service with the Royal Air Force should have attracted most attention at this session of the Conference. His paper provided a striking illustration of technical and scientific development stimulated by the War; but Mr. W. C. Devereux's paper on research and development applied to light alloys was more instructive with regard to the main purpose of the session. Mr. Devereux gave a most striking picture of the way in which scientific advances, such as Dr. W. Hume-Rothery's brilliant work in metallurgical physics at Oxford, and new techniques such as X-ray diffraction, are opening up new possibilities in this field. Like Lord McGowan, he referred to the twin function of

the universities in advancing knowledge of science and in providing industry with men qualified to interpret this new knowledge. Industry also must play its part by making scientific posts sufficiently attractive to ensure a steady stream of the right type of men through the universities. He also suggested that the universities might take stock of the position arising out of the demand for scientific men fully qualified for the higher posts in research management and administration, for which there is at present an undoubted lack of suitable men. Mr. Devereux commented on the way in which the volume of routine testing is increased by lack of fundamental knowledge of the properties of materials; and describing the development work at Light Alloys Ltd., said that in addition to a Process Development Department dealing with the development of new processes and improvement of old processes within the scope of their normal activities, there is an Engineering Development Department concerned with the development of new ideas and the engineering uses of the products manufactured. Dr. J. C. Swallow, in the course of a brilliant short paper on plastics, contrived to give not only a lucid exposition of the structural relations of the synthetic organic thermoplastics, such as polymethyl methacrylate, polyvinyl chloride, nylon, polythene, polyisobutylene, but also to demonstrate the variations in their properties, with a deftness and nonchalance that a conjurer might have envied. This he followed up by indicating clearly and concisely what is involved in the industrial development of such products: the close co-operation of the organic and the physical chemist, the physicist, the chemical engineer and the engineer, and the importance of the development of knowledge of the fundamental principles of plastic flow, and the perfection of methods of measurement both in regard to the application and the manufacture of plastics, though Dr. Swallow observed that in such industrial developments there is art as well as science. Above all, it is important to have available as many clarifying principles as science can provide, relating properties to structure, in order to be able to select and concentrate on the development of those plastics likely to be the most useful and to prevent dissipation of research effort.

The story which Mr. A. L. Bacharach had to tell of the synthetic vitamin industry was no less fascinating; and if the session seemed to come to a lame conclusion and the red lights came on insistently for the first time, it was rather because of Mr. Bacharach's failure to prepare his material adequately with reference to the time factor, so that discussion of the questions to which his account of the development and possibilities of this new industry, not merely for therapeutics, but also in nutrition and the food industries generally, naturally led, was prematurely terminated. Mr. Bacharach pointed out that this new branch of chemical industry is less than twenty years old, and that not all the products are in the strict sense synthetic; they may be extracted from natural sources or degraded from natural compounds. All the important discoveries on which the industry is based were made in university or institutional laboratories, and even the isolation, purification or determination of constitution was effected in such laboratories and not in industrial laboratories. The type of problem is one calling almost solely for the co-operation of the organic chemist and the chemical engineer. Finally, Mr. Bacharach emphasized the identity of the natural and synthetic vitamins, and the widely varying scale on which the various processes of manufacture are carried on.

The final session of the Conference was devoted to "The Future: What Science might Accomplish", and in presiding over this session, Lord Woolton spoke of the lessons for peace of war-time triumphs. Rejecting alike the totalitarian approach with its abandonment of freedom and the *laissez-faire* doctrine of trusting to chance, Lord Woolton believes that public opinion will demand that in certain spheres the Government should exercise a greater influence than it did before the War, and that if we use the knowledge we have gained of necessity in war, we have much material on which to reconstruct a healthier and happier society in the future. Within a few weeks of his taking office as Minister of Food in April 1940, we were faced with a 50 per cent drop in our food imports, and were saved from starvation by the application of scientific knowledge to the problem of securing the right foods, not to satisfy our appetites, but to meet nutritional needs. Advances which scientific research has made in handling food, such as dehydration, both saved shipping space and preserved food, while in agriculture scientific research has made it possible to increase yields beyond all expectation. Steps taken to increase the consumption of milk, to encourage the eating of selected vegetables, to provide certain classes with orange juice, cod-liver oil, vitamins and calcium tablets, to develop communal feeding and meals in factories, and to expand the scheme for meals in schools, should form a permanent part of our health programme. Lord Woolton urged the British Association to continue its educational work in the field of nutrition, and said that in the fields of housing, in trade and industry, and the effective use of man-power, we should also seek to turn to account the lessons and experience of the War. He fully agrees that post-war reconstruction should begin with housing: that involves determining the standard of housing that will enable people to live healthy lives, and then the application of scientific knowledge to the design and construction of houses.

For the best uses to be made of our scientific resources, there must be closer contact between scientific workers in industry and those in the universities, more integration between research and development, and more pooling of information about new developments. The State and industry must see that scientific research, whether medical, agricultural, industrial or fundamental, is adequately endowed.

Mr. E. Carter followed with a paper on science and housing, in which he pointed out that the comparatively few advanced modern houses built between the Wars must be regarded as laboratory models rather than parts of a housing achievement. He urged that housing should be considered as primarily a social problem, taking account of potentialities rather than actualities. The contribution of science, he suggested, has three aspects: definition of the problem, which involves a large extension of a scientific survey of the attitudes of people to their domestic life and equipment, of the dynamics of family living, and of the physical factors that govern house plan and equipment, sizes and shapes. Secondly, we have to provide solutions, bring all our techniques, material and equipment to a high pitch of efficiency and to co-ordinate them into integrated designs for dwellings and communities. Finally, there is the operations stage—the business of economics, scientific manage-

ment, production and job supervision. Scientific workers, said Mr. Carter, are not happy working to make low standards tolerable, nor will they for long be content to design high standards which cannot be translated into the real life of the mass of the people.

No brief summary could do justice to this highly suggestive paper or to those which followed from Sir Joseph Barcroft on food and from Prof. J. M. Mackintosh on health. Sir Joseph Barcroft, pointing out how little we know of nutrition in regard to the brain, gave a glimpse of the possibilities if the nourishment of our central nervous system could be placed on an ascertained basis. Predicting a great change within ten years with regard to the certainty of our knowledge of the relation of food to man, Sir Joseph indicated some of the problems, such as those of flavour, requiring investigation, and the decisions which will have to be taken in regard to milk policy, meat policy and the like. He also referred to the shortage of research workers; many more will be required to prosecute on any adequate scale the investigations on the nutritional demands of muscular exercise, mental work and maternal potentiality which lead to rational or functional nutrition.

In a brilliant survey of what preventive medicine might accomplish, Prof. J. M. Mackintosh suggested that surgical science is still only in the clumsy experimental phase of its childhood, and that plastic surgery has only just begun to take shape. Recent advances in plastic surgery are not merely refinements in technique, but rather the progressive application of new biological knowledge; recent work on the lungs, the nerves and the blood vessels has opened up great highways for the march of science. Surgery has secured a powerful ally in biochemistry, but the mechanical expert is badly needed in the surgical repair shop, and the chemist must be called in to help in the search for non-irritant materials which can be used in surgical architecture. In preventive medicine, Prof. Mackintosh said we must recognize the environmental factors, represented by sanitary science, housing, town planning and the like, and the personal factors, with the family and social background. He stressed the importance of water supply and also atmospheric pollution: smoke prevention is one of the immediate tasks of sanitary science. On the personal side, preventive medicine stands at the door of opportunity, and the brilliant discoveries of bacteriology and biochemistry have yet to be applied. We have still to organize concerted attacks on such problems as tuberculosis, and we should also be deeply concerned with the positive aspects of prevention; there is need, for example, for a new spirit of health organization in industry, especially for the benefit of the smaller occupations and the widely distributed activities of transport and service. Finally, Prof. Mackintosh referred to the possibilities in the field of international health, and urged the importance of co-operation between the medical and other technical experts, in which each should be ready to subordinate his ideal to the common purpose.

Sir Lawrence Bragg, speaking on the place of science in industry, said that although the British have a fine record in pure science and seem to breed the right type of man for breaking new ground, initiating new branches of science and solving old problems in an unexpectedly simple way, there are three bottlenecks which are restricting the vitalizing function of science in industrial and national affairs. First, the fact that science is not yet a recognized part of a good general education, especially the higher education of those from whom the leaders of the future are likely to emerge. Secondly, he finds a very general reluctance of the most brilliant of young scientific workers to enter industry; and thirdly, the disposition of young people with a good deal of idealism to desire work directed mainly by considerations of social service. Sir Lawrence Bragg thinks that the War has indicated means of overcoming these difficulties, and finally he pointed out that when we ask what science might accomplish we should also ask what do we wish it to accomplish. The higher achievements of the human spirit are founded on man's command over Nature, and the wider and stronger science can make that foundation the higher the edifice which can be built upon it.

In summing up the Conference, Sir Harold Hartley commented that he had not found, as a teacher of chemists, the difficulty to which Sir Lawrence Bragg referred. Emphasizing a number of points which came out, such as the stimulus which science and industry mutually derive from one another, the impact of one industry on another, he referred to the general agreement on the need for greatly increased support for research, and particularly for more endowment by the State, and for making a scientific career really attractive and giving the scientific worker full encouragement and freedom to work in the way in which he can best develop his powers. There is agreement that the shortage of man-power makes it imperative to see that trained intelligence is directed into the right channels, and if the Conference contributes to a general realization of what has been done and how much still remains, it has also clearly indicated something of what is possible if we harness the brain power of the scientific worker to the improvement of the prosperity and welfare of the community.

CROP PRODUCTION IN NUTRIENT SOLUTIONS

By SIR JOHN RUSSELL, F.R.S.

SEVEN years ago Prof. W. F. Gericke, of the University of California, published an article in *Science* under the title "Hydroponics—Crop Production in Liquid Culture Media", and he followed this up in 1940 by a book, "Complete Guide to Soil-less Gardening". The idea attracted certain people very strongly, and before long it was necessary for some of the staff of the University to point out that some at least of the claims that were being put forward lacked good evidence. The method was critically but impartially investigated in Great Britain by Prof. R. H. Stoughton, of the University of Reading, Dr. G. H. Bewley, of the Cheshunt Research Station, and Messrs. W. G. Templeman and S. J. Watson, of Jealotts Hill, and it is now possible to obtain a much more complete view than could be done before.

In principle, it is the water-culture method familiar to generations of botanists: plants are grown in nutrient solutions and not in soil. But the scale is different. Instead of individual plants each in its own bottle, the plants are grown in considerable number in specially constructed troughs holding the culture solution, the seed or seedling being supported on a specially prepared bed of vegetable litter.

Prof. Gericke has recently pointed out an important difference between the culture medium and the soil which may open up some interesting scientific problems. Hitherto, he says, agricultural chemists have devoted much attention to the relations of the soil and plant growth. The soil was studied as the anchorage for the plant, and the different types of soil were known to induce different types of root development. There is, in fact, some kind of relationship between soil type and the architecture of the root. Further, the soil is the reservoir for water for the plant. It will not give up all that it holds, and much important work has been done on the partition of water between soil and plant. Finally, the soil plays an important part in the mineral nutrition of the plant, holding the phosphates and potash in various degrees of intensity; again there is something like a partition.

Prof. Gericke points out that all these relationships disappear in water culture. What is wanted now, he says, is a study of the plant in relation to the culture solution; and this will obviously lead to very different results from those obtained in connexion with soil.

For a given plant, the root system is much less varied in water culture than it is in soil. Roots in water culture are neither as thick or as thin, nor as long or as short, as they can be in different soil types, nor do they live as long. On the other hand, many more new roots arise from the root crown in water culture than in soil. The effect on total growth varies with the plant. Some kinds of plants make better growth than in soil, others less. This narrowing of the range of variation of the roots leads to a further result: the mineral compositions of different species when grown together in the same nutrient solutions are more alike than when they are grown together in the same soil.

On the other hand, a somewhat wide variation in the composition of the nutrient solution is permissible; there is no optimum ratio of the nutrient elements, nor an optimum *p*H value. Certain elements, however, are needed in larger amounts than others, and some are toxic if present in excess.

The subject of hydroponics, however, was not put forward to encourage the study of the relations of plant roots to water; it was to be an alternative to soil culture. Experiments in Great Britain have not given results so promising as some of those reported from California. As mentioned above, they have been made at three stations: the University of Reading, Jealotts Hill and Cheshunt. All failed to obtain the huge crops of tomatoes—200 tons per acre—claimed in California; and in fact they obtained no better results than in soil. Prof. Stoughton attributes this to the low light intensity prevailing in Britain and to the difficulty of ensuring adequate aeration for the roots.

As an alternative, Prof. Stoughton prefers sand culture, in which the nutrient solution is periodically pumped up into the vessel containing the plants and then allowed to return to the supply tank; this ensures adequate aeration of the roots and, for certain flowers at any rate, it has given better results than the water-culture method*. The best plants are usually no better than the best in soil, but there is greater uniformity, and in consequence better average yields. Certain difficult plants also appear to grow more freely in sand culture than in soil.

Dr. Bewley's experience has been on similar lines. He did not get better crops of tomatoes in sand culture than in soil, but of course his standards are high and he is no stranger to a crop of 80 tons per acre growing on steamed soil. But he also finds that certain flowers do better in sand culture than in soil. Carnations came earlier and in greater quantity, though it did not appear that their quality was as good as in soil.

Prof. Stoughton arranged for chemical analyses of some of the crops grown in sand culture to see if there was any evidence of inferior nutritional value as compared with crops grown in soil. But none could be found. As against this, Prof. Gericke states that the protein content of plants grown in nutrient solutions does not rise so high as it can do in soil.

Thus it appears that the growth of plants in nutrient solutions opens up a number of scientific problems, especially those related to root growth and the phenomena of flowering; and it opens up also many practical problems which when the War ends will no doubt be seriously studied. But it can be said at once that there is no evidence that any significant contributions to war-time food supply of Britain can be expected from the method.

* For details, see Stoughton, R. H., *J. Roy. Hort. Soc.*, **66**, 17 (1941).

THE TAXONOMY OF BRITISH BRYOPHYTES AS A FIELD FOR RESEARCH

By DR. P. W. RICHARDS
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THE note in *Nature*[1] on the recently published history of the British Bryological Society ends with these words: "The taxonomy of mosses and liverworts is now largely established, but many bryological matters still require elucidation. Perhaps the post-war period will provide opportunities for detailed ecological studies—the relation of a moss or liverwort to its substrate, its reactions with other plants, and particularly of its unique physiology, which allows a special phenology of reproduction not possessed by any other kind of plant". With the second part of this statement every student of the bryophytes will be in warm agreement; but the first part, with its implication that taxonomically the bryophytes are an exhausted field, perhaps conveys a misleading impression. It may therefore be worth while to survey briefly the present position of bryophyte taxonomy so far as it concerns the British Isles.

The systematic study of the mosses and liverworts has long been established in Britain. In the eighteenth and nineteenth centuries British botanists made very notable contributions to the taxonomic study of these groups. Since then, though workers on the bryophytes have, of course, been few compared with those concerned with other groups of plants, the British contribution to bryophyte taxonomy has still been large, the work of the late Symers MacVicar and W. E. Nicholson on the liverworts and of the late H. N. Dixon on the mosses being especially important. British bryologists are fortunate in having in MacVicar's "Student's Handbook of British Hepatics"[2] and Dixon's "Student's Handbook of British Mosses"[3] two excellent handbooks in which the known species and varieties are admirably described and figured. Such works as these, however, can never be final or impossible to improve; they should mark the begin-

ning rather than the end of a period of development.

Since the publication of the last editions of Dixon's and MacVicar's "Handbooks" a number of important additions have been made to the British bryophyte flora. The chief additions among the liverworts are *Cephalozia affinis* Lindb. (Jones[1]), *Scapania apiculata* Spruce var. *Jonesii* Nicholson (Nicholson[5]) and *Telaranea nematodes* (Gottsche) Howe (Buch[6], Richards[7]), a member of a monotypic genus previously known only from tropical America and Africa, but afterwards reported from the Azores and western Pyrenees. Further, British workers seem to have overlooked the fact that *Scapania parvifolia* Warnst. and *S. paludicola* Loeske and K. Müll. have been recorded as British by Buch[8]. Among the mosses the Mediterranean *Cheilothela* (*Ceratodon*) *chloropus* (Brid.) Lindb. (Binstead[9]) and the long dubiously British *Cinclidotus riparius* (Host.) Arnott (Nicholson[10]) have been added to our flora, while recently Heslop-Harrison and Cooke[11] have found in the Hebrides *Andreaea Hartmanii* Thed. and *A. Blyttii* Schp., both previously known only from Scandinavia, as well as *Aongstroemia longipes* Sommerf. and *Cirrphyllum* (*Eurhynchium*) *Boscii* (Schwaeg.) Grout, the last-named being new to Europe. These discoveries show that among species generally recognized in other countries additions to the British flora are still to be expected.

The main need, however, is not so much for the intensive search for additional species as for a critical re-examination of those long known to occur, especially of those in polymorphic groups. It is generally recognized that both the mosses and liverworts abound in highly plastic species. Though some bryophytes, for example, *Breutelia chyrsocoma* (Dicks.) Lindb., *Bazzania trilobata* (L.) Gray, seem to be extremely stable and vary remarkably little, even under the most diverse environmental conditions, many species are notoriously variable, the ubiquitous *Hypnum cupressiforme* Hedw. being an outstanding example. Observations in the field at once suggest that much, though not all, of this variation is due to the direct modifying effect of the environment; by carefully noting how far different variants can be found growing side by side in the same environment, and how far they always occur in obviously distinct habitats, something can be done towards determining to what extent the variation is phenotypic and to what extent genotypic. It is clear, however, that the systematics of these polymorphic species can only be placed on a firm foundation if they are studied experimentally under controlled conditions.

In Great Britain, as yet, practically nothing has been done on these lines, but the work of H. Buch on the liverworts of Finland shows how profitable such researches are likely to be. Buch's methods[12] rest on the simple postulates that, (*a*) genotypically similar types may appear phenotypically different when grown in different environments, (*b*) genotypically different types appear different when grown in the same environment. Wild material of 'critical' species is transplanted either from one natural habitat to another, or from different natural habitats to an as far as possible uniform 'standard' environment—Buch's 'standard' environment consisted of a peat substratum in a wooden box with a loosely fitting glass lid kept in a living-room which was heated during the winter so that neither humidity nor temperature fluctuated very violently. Using these simple methods, Buch obtained results of great interest and significance for taxonomy. His work[13] on the *Lophozia ventricosa* group of leafy liverworts may be used as an illustration.

In MacVicar's "Handbook" eight 'species' in this group are recognized: (1) *L. ventricosa* (Dicks.) Dum., (2) *L. porphyroleuca* (Nees) Schiffn., (3) *L. guttulata* (Lindb. & Arn.) Evans, (4) *L. Wenzelii* (Nees) Steph., (5) *L. confertifolia* Schiffn., (6) *L. alpestris* (Schleich.) Evans, (7) *L. longidens* (Lindb.) Macoun, (8) *L. longiflora* (Nees) Schiffn. Buch was able to show that of these (1), (2), (4), and (6) were well-characterized species which remained obviously distinct when grown under the same conditions; *L. guttulata* proved to be a modification (phenotypic form) of *L. porphyroleuca* produced by conditions of strong illumination and evaporation, and *L. confertifolia* was found to be a parallel modification of *L. Wenzelii*. The status of *L. longiflora* remained undecided. During the investigations the existence of two new species in the group, neither of which has yet been detected in Britain, was disclosed; one of these, *L. silvicola* Buch, is recognized mainly by the highly characteristic appearance of the oil-bodies in the cells, a character which is only observable in living material, the species being impossible to separate from *L. ventricosa* on herbarium material alone. The morphological differences between *L. Wenzelii* and *L. ventricosa*, and between *L. porphyroleuca* and *L. ventricosa* respectively, are comparatively small, and as both *L. Wenzelii* and *L. porphyroleuca* have more specialized habitat preferences (bare rock and rotten wood respectively) than *L. ventricosa*, Buch suggests that they are comparable with Turesson's ecotypes among the higher plants.

In other genera very similar results were obtained. In the genus *Scapania*[8] culture experiments showed that *S. undulata* (L.) Dum., *S. dentata* Dum. and *S. intermedia* (Husn.) Pears were all modifications of one and the same species which could readily be transformed from one into another. The distinctness of *S. undulata* and *S. dentata* as 'good' species had previously been generally accepted. In the genus *Calypogeia*, Buch[14] found that what had hitherto been regarded as a mere variety of *C. Neesiana* (Carest. & Massal.) K. Müll. proved to be a thoroughly distinct species when grown side by side with normal *C. Neesiana* under cultural conditions.

Since the modifications of different species under diverse environmental conditions are strikingly parallel, Buch suggests that a uniform system of nomenclature should be applied to the modifications of all plastic species of leafy liverworts. For example, modifications with strongly thickened cell walls which occur under conditions of high evaporation should be called mod. (=modificatio) *pachyderma*, while those with reddish or otherwise pigmented cell walls (found in strongly illuminated habitats) should be called mod. *colorata*. A modification combining more than one such character could be referred to by a combined name, for example, mod. *pachyderma-denticulata-colorata*. Whether this system of nomenclature is feasible can only be shown by experience, but in any event the suggestion is an interesting one as showing the widespread occurrence of parallel phenotypic variations in this group of plants.

It would be of great value to extend Buch's experimental methods to all our polymorphic groups of mosses and liverworts. So far almost nothing of the kind has been attempted for the mosses, though unpublished experiments by the author have shown that the well-known sand-dune moss *Tortula ruraliformis* (Besch.) Dix., which is variously regarded as a

variety or a 'sub-species' of the common inland species *T. ruralis* Hedw., retains its distinctive characters when cultivated side by side with *T. ruralis* under experimental conditions.

The group of mosses to which the application of this technique is most urgently necessary is the genus *Sphagnum*, a genus which, as is well known, has been a fruitful field for the species 'splitter'. Anyone who is familiar with the genus in the field realizes that it is a particularly plastic one in which phenotypic variation is readily induced by differences in water-level, in exposure to light, etc. Warnstorf, who monographed the genus for Engler's "Pflanzenreich", described a vast number of species of which a large proportion are almost certainly merely modifications. Following Warnstorf's delimitation of the species, no less than 47 sphagna have been recognized in Britain, each with a multitude of varieties and forms. Le Roy Andrews[15], on the other hand, on the basis of careful herbarium studies alone, would reduce our number to about twenty-six. In the particularly difficult group of the *Sphagna subsecunda*, Åberg[16], after a very careful study (though without using experimental methods), recognizes only three European species as compared with the eighteen recognized by Warnstorf. In one locality in Sweden he observed a 'natural experiment' in which owing to the falling of the water-level in a lake an originally uniform carpet of *S. subsecundum* Nees var. *innundatum* (Russ.) emend. had become transformed into two modifications, one growing in the water and one above it; these modifications, according to Åberg, would certainly have been regarded by Warnstorf as distinct species.

The introduction of experimental methods is not the only improvement desirable in our taxonomic technique. Great advances can be made by making methods of description more precise and refined; Buch, in his admirable monograph[8] of the *Scapania* species of northern Europe, has shown how much can be done in this direction. Bryophytes are plants in which many taxonomically useful characters (cell size, ratio of length to breadth of leaves, seta length, etc.) are readily measurable and may be treated statistically. Several workers have already successfully demonstrated the value of statistical methods in bryophyte taxonomy (for example, Malta[17], Walther[18], Wynne[19]). As with the higher plants, a combination of cytogenetic with taxonomic methods is certain to be fruitful. Evans[20] showed that all forms of the genus *Dumortiera* fall into one of two morphological groups; afterwards it was shown[21] that in one group the haploid chromosome number was 9, while in the other it was 18. Burrell[22] has suggested that *Orthodontium gracile* (Wils.) Schwaeg. var. *heterocarpum* Watson, which is rapidly spreading in the British Isles, is a polyploid of recent origin.

Up to now this article has been concerned only with the species and minor taxonomic units, but advances can also be looked for in 'major' taxonomy. With changing views on the phylogeny of the liverworts (cf. Harris[23]) and a general recognition that the simpler types are reduced rather than primitive, a need for a revision of the classification has been felt. Classifications in harmony with the new views have been put forward by Verdoorn[24] and by Evans[25]. A check-list of the liverworts of Europe and North America arranged according to Evans' classification has been published by Buch, Evans and Verdoorn[26]; this list embodies Buch's[27] useful subdivision and re-classification of the obviously artificial genera *Lophozia* and *Sphenolobus*.

For the mosses the scheme of classification proposed by Fleischer and adopted with various modifications in the second edition of Brotherus' two volumes on the Andreaeales and Bryales in Engler's "Pflanzenfamilien" has obtained general acceptance among Continental bryologists. In Britain the older classification adopted in Dixon's "Handbook" is still in vogue; but it seems high time that Fleischer's system came into use in Great Britain also.

From this short survey it will be clear that the taxonomy of the bryophytes offers abundant problems for research. There is still much to be done both for the amateur and the professional worker, especially if the words of that stimulating bryological critic, L. Loeske[28], are borne in mind, "Es gibt für die Systematiker keine höhere Forderung als die, auch zugleich Biologe zu sein". In the British Isles we have an exceptionally rich and varied bryophyte flora. If the great opportunities that lie open to us are not to be lost, more research on bryological taxonomy is required. It is at least to be hoped that after the War one of our great national herbaria will find it possible to appoint a member of its staff whose whole time is devoted to this much-neglected group of plants.

[1] *Nature*, **153**, 768 (1944).

[2] MacVicar, S. M., "Student's Handbook of British Hepatics". Ed. 2 (Eastbourne, (1926).

[3] Dixon, H. N., "Student's Handbook of British Mosses", Ed. 3 (Eastbourne, 1924).

[4] Jones, D. A., "*Cephalozia affinis* Lindb. in Ireland", *Rep. Brit. Bryol. Soc.*, **3**, 294 (1935).

[5] Nicholson, W. E., "A New *Scapania* from Ireland", *J. Bot. Lond.*, **76**, 15 (1938).

[6] Buch, H., "*Telaranea nematodes* aus Irland", *Ann. Bryol.*, **9**, 32 (1938).

[7] Richards, P. W., "*Telaranea*, a Genus of Hepatics, New to Europe, Discovered in Ireland", *Proc. Linn. Soc. Lond.* 150th sess., 116 (1938).

[8] Buch, H., "Die Scapanien Nordeuropas und Sibiriens", *Soc. Sci. Fennica, Comment. Biol.*, **3**, 1 (1928).

[9] Binstead, C. H., "*Ceratodon chloropus* Brid. in Britain", *J. Bot., Lond.*, **67**, 212 (1929).

[10] Nicholson, W. E., "*Cinclidotus riparius* (Host.) Arnott", *Rep. Brit. Bryol. Soc.*, **2**, 358 (1931).

[11] Heslop-Harrison, J. W., and Cooke, R. B., "*Andreaea Hartmanii* Thed. and *A. Blyttii* Schimp., Two Mosses New to the British Isles, from the Hebrides, with Remarks on other Hebridean Species of the Genus", *J. Bot., Lond.*, **80**, 35 (1942).

[12] Buch, H., "Eine neue moossystematische Methodik nebst einigen ihrer Resultate und ein neues Nomenklatursystem", Rept. 18 Scand. Naturalist Congr. Copenhagen, 26–31 Aug. 1928.

[13] Buch, H., "Experimentell-systematische Untersuchungen über die *Lophozia Ventricosa*-Gruppe", *Ann. Bryol.*, **6**, 7 (1933).

[14] Thériot, I., Dixon, H. N., and Buch, H., "Bryophyta nova", *Ann. Bryol.*, **7**, 157 (1934).

[15] Le Roy Andrews, A., "Notes on the Warnstorf Sphagnum herbarium—I", *Ann. Bryol.*, **9**, 3 (1936).

[16] Åberg, G., "Untersuchungen über die Sphagnum-Arten der Gruppe Subsecunda in Europa, etc.", *Ark. Bot.*, **29**, 1 (1937).

[17] Malta, N., "Die Gattung *Zygodon* Hook. et Tayl.", *Latvijas Univ. Bot. Dārza Darbi* 1.

[18] Walther, K., "Untersuchungen über die Variabilität innerhalb des Formenkreises von *Polytrichum juniperinum*", *Ann. Bryol.*, **7**, 121 (1934).

[19] Wynne, F. E., "Studies on *Drepanocladus*—I", *Bull. Torrey Bot. Cl.*, **71**, 207 (1944).

[20] Evans, A. W., "A Taxonomic Study of *Dumortiera*", *Bull. Torrey Bot. Cl.*, **46**, 167 (1919).

[21] Lorbeer, G., in Verdoorn, F., "Hepaticae selectae et criticae, series III et IV (1932)", *Ann. Bryol.*, **5**, 125 (1932), 142.

[22] Burrell, W. H., "A Field Study of *Orthodontium gracile* (Wilson) Schwaegrichen and its Variety *heterocarpum* Watson", *Naturalist*, 295 (1940).

[23] Harris, T. M., "The British Rhaetic Flora" (London, 1938).

[24] Verdoorn, F., "Classification of Hepatics" in "Manual of Bryology" (The Hague, 1932).

[25] Evans, A. W., "The Classification of the Hepaticae", *Bot. Rev.*, **5**, 49 (1939).

[26] Buch, H., Evans, A. W., and Verdoorn, F., "A Preliminary Check List of the Hepaticae of Europe and America (North of Mexico)", *Ann. Bryol.*, **10**, 3 (1938).

[27] Buch, H., "Vorarbeiten zu einer Lebermoosflora Fenno-Scandias. I. Ein Versuch zur Aufteilung der Gattungen *Lophozia* Dum. und *Sphenolobus* Steph.", *Mem. Soc. pro Fauna et Fl. Fenn.*, **8**, 282 (1933).

[28] Loeske, L., "Bemerkungen zur Systematik der Laubmoose", *Ann. Bryol.*, **8**, 131 (1935), 148.

OBITUARIES

Dr. E. L. G. Clegg

THE hand of death has fallen heavily on the Geological Survey of India during the past few years; for we have lost in turn, and at a comparatively young age, Cotter (1941), Pilgrim (1943), and Christie (1944), all retired from the Department. Now we have to lament the death of a serving officer, Dr. Edward Leslie Gilbert Clegg, who passed away on September 8, 1944, some days after an operation in the General Hospital, Calcutta.

At the time of his death Clegg was director of the Geological Survey, having succeeded Sir Cyril Fox so recently as July 1943. For the purpose of helping in the great industrial expansion that is now seen to be necessary if India is to rise to her proper status in the world, the Geological Survey of India is in process of expansion to a strength much greater than before the unfortunate and ill-judged retrenchment of 1931. As Clegg had, throughout his service, shown himself to be possessed of a large modicum of common sense and a flair for administration, he was essentially the man for the job of director, and his untimely death must be regarded as nothing less than a calamity both to his Department and to India.

Clegg was born on February 24, 1894, at Manchester. He was educated at the Central High School (1904–12) and Victoria University, Manchester (1912–15 and 1919–20). He served through the War of 1914–18 as an officer in the Northumberland Fusiliers and saw much active service in France and Italy. After the War he returned to Manchester, took the M.Sc. degree in geology, and was then (1920) appointed an assistant superintendent in the Geological Survey of India.

For his first field-season, Clegg was posted to my party in the Central Provinces, and after accompanying me for a time, he was given an independent piece of work on the Archæans of the Nagpur district. Except for water-supply inquiries, and charge of work in the Central Provinces and of sulphur operations in Baluchistan after his return from Burma in 1942, this proved to be the only field-work Clegg did in India *strictu sensu*. For in his second field-season he was posted to Burma, where practically all his field work was done in two spells. Between these two spells Clegg was at headquarters in Calcutta, first as curator of the Geological Museum, and then as officer-in-charge of the Geological Survey Office. During this period he acted also as lecturer in geology at Presidency College and at the Bengal Engineering College, Sibpur. In addition he took a keen interest in the Mining and Geological Institute of India, acted as one of the joint honorary secretaries during 1927–30, and was vice-president in 1943. He became a D.Sc. of Manchester in 1939.

In 1932 Clegg was promoted to the grade of superintendent, and placed in charge of the Burma Circle. On account of the approaching separation of Burma from India, it fell to my lot to devise a scheme by which geological survey work in Burma could be continued after separation; for Burma would then have no geologists, unless a portion of the Indian Geological Survey was to be cut off. The solution adopted was to form a new department, the Burma Geological Department, and staff it with officers seconded (on foreign service) from the Indian Survey for periods of five years at a time, until Burma could recruit her own geologists. Meanwhile the scientific results of the work of the new Department were to be published in the *Records* and *Memoirs* of the Geological Survey of India, and this course has been followed up to date.

The separation took place on April 1, 1937, and Clegg became the first superintendent of the new Department, taking orders direct from the Government of Burma, instead of from the director of the Geological Survey of India. With the invasion of Burma by the Japanese, Clegg returned to India after making a valuable traverse through the Hukawng valley for the military (for a road through to India), emerging at Margherita in Assam in June 1942. It is perhaps not out of place to record that Mrs. Clegg, with Mr. and Mrs. Anil Dutt (also of the Indian Survey), travelling by a route since made famous by the 14th Army, escaped from Burma in March 1942 *via* the Kalewa–Kabaw valley and Tamu to Palel in Manipur, walking the whole way, with coolies to carry their few possessions and a servant to push or carry a bicycle. From Palel they continued by motor-bus through Imphal to Dimapur and thence by train to Calcutta.

While in charge in Burma, Clegg had occasion to visit most of the Burmese mineral deposits in order to advise the local government on their mining administration, and on the many problems that arise in the grant of mineral concessions. He also obtained an intimate knowledge of the Burmese oilfields while acting as resident geologist at Yenangyaung in 1935 and 1936. This experience enabled him to write a valuable account of the "Mineral Deposits of Burma", published by the Government of Burma (1940). He also contributed the articles on lead, silver, tin, wolfram, and zinc, to the last "Quinquennial Review of the Mineral Production of India", and finally, in 1944, a bulletin on tin and wolfram to the *Records of the Geological Survey of India*.

On account of his administrative duties, Clegg had less opportunity for systematic field survey work than would otherwise have been the case. Nevertheless he has two important memoirs to his credit. The earlier one, "The Geology of Parts of the Minbu and Thayetmyo Districts, Burma" (*Mem. Geol. Sur. Ind.*, 72, Pt. 2, 137; 1938), contains an account of his work in these districts, mainly during his earlier spell in Burma. In making use of the writings and maps of his predecessors and of contemporary workers in this and adjoining tracts, Clegg shows a capacity for digesting the work of others and of expounding the combined results with the impartiality of a balanced mind, qualities very useful for the director-to-be of a Geological Survey. Those who wish to follow the tangled story of the nomenclature of the Burma Tertiaries cannot do better than consult this memoir.

On his return to Burma as superintendent of the Circle in 1932, Clegg was set the task, with the assistance of Dr. Narayana Iyer, of making a detailed map of the Ruby Mines area of Mogok, which had already been commenced by Dr. Coggin Brown and Mr. A. K. Banerji, and for which new large-scale maps had been specially prepared by the Survey of India. In three field-seasons Clegg and Iyer completed this survey, but the results have not yet been published. Clegg was not satisfied that the marbles and gneisses of the Mogok tract were Archæan in age, as was generally supposed; consequently he seized every opportunity of making traverses in northern Burma (the defiles of the Irrawaddy, the Jade Mines District, Mongmit State) in a search for clues. This led to important results, with the discovery of a new foraminifer

(*Orbitolina birmanica* Sahni), regarded as of Upper Cretaceous age and found not only in the limestones and mudstones of both defiles of the Irrawaddy, but also in the limestones of the Jade Mines District, which in places are highly crystalline, with rubies and spinels. In consequence wide tracts of Upper Burma, both of sedimentary and volcanic rocks, are now regarded as Cretaceous in age, where rocks of this age were not previously suspected to occur. Clegg gives a full account in his second memoir "The Cretaceous and Associated Rocks of Burma" (*Mem. Geol. Sur. Ind.*, 71, Pt. 1, 1; 1941). As the original inspiration for this work was derived from his study of the Mogok area, it is not surprising that Clegg makes a valiant attempt to show that the ruby-bearing limestones of Mogok are also of Cretaceous age. Unfortunately, in his traverse across Mongmit State in the north to the Mogok area in the south he was frustrated by a "gap of about three miles between the definitely shelly limestone rocks of the Cretaceous series and totally re-crystallised and homogeneous limestones of the Mogok series" (*loc. cit.*, p. 29). The gneissic and schistose rocks of the Mogok area are, however, as highly metamorphosed as those of the Eastern Ghats area of India, or of Ceylon, being uniformly of hypometamorphic grade, including, for example, khondalite (see *Rec. Geol. Sur. Ind.*, 68, 27). I have myself twice visited the Mogok tract, once with Dr. Coggin Brown, and once with Dr. Clegg, and I find it difficult to accept the view that in the main the Mogok tract is not an Archæan outlier of the Indian section of Gondwanaland. The Kamaing granite is, however, definitely intrusive in the Mogok series and may be of the same age as the granitic axis that forms the backbone of the Indo-Malayan Peninsula, and is known to be post-Triassic in age and perhaps Upper Cretaceous. However, Clegg has disturbed the complacency of Archæan enthusiasts, and should the Mogok gneiss, including the marbles, be eventually proved to be of much younger age, to Clegg will belong the credit of having created the doubt.

Besides being a good geologist and administrator, Clegg was a good athlete. He made many friends; and I personally look back with pleasure on times spent together in camp and at social gatherings, as well as to the splendid service he gave in all tasks both executive and administrative with which he was entrusted.

In 1926 Clegg married Helen Goode, a botany graduate of Manchester, and he leaves two sons.

For some of the facts of this note I am indebted to an excellent obituary notice in the October 1944 number of *Science and Culture*, by Dr. H. Crookshank, who has succeeded Clegg as director of the Geological Survey of India. L. L. FERMOR.

WE regret to announce the following deaths:

Dr. Guy D. Bengough, F.R.S., consultant to the Chemical Research Laboratory of the Department of Scientific and Industrial Research, on January 20, aged sixty-eight.

Sir Buckston Browne, honorary fellow of the Royal College of Surgeons, a generous benefactor of the British Association, on January 19, aged ninety-four.

Sir Henry Gauvain, past president of the Sections of Electrotherapeutics and of the Diseases of Children of the Royal Society of Medicine, an authority on tuberculosis, on January 19, aged sixty-six.

NEWS and VIEWS

Prof. G. M. Bennett: Government Chemist

PROF. GEORGE MACDONALD BENNETT has been appointed to succeed the late Sir John Fox as Government Chemist. His appointment recalls those of two previous Government Chemists, Sir Edward Thorpe and Sir James Dobbie, each of whom was professor of chemistry before becoming Government Chemist.

Prof. Bennett received his earlier education at the East London (now, Queen Mary) College and proceeded to St. John's College, Cambridge, of which he later became a fellow after taking first classes in Parts I and II of the Natural Sciences Tripos. In 1917 he began original investigations in physical chemistry and on chemical problems of national importance at the time. After leaving Cambridge he was appointed successively demonstrator in chemistry at Guy's Hospital Medical School, lecturer in chemistry in the University of Sheffield and Firth professor of chemistry there in 1931. He was appointed to his present professorship in chemistry in the University of London at King's College in 1938. Prof. Bennett is also honorary secretary of the Chemical Society—an arduous office which brings the holder into contact with chemists generally and with chemical and organization problems of diverse types.

Prof. Bennett's record as an investigator is outstanding. He has made major contributions particularly to organic chemistry and to the stereochemistry of sulphur compounds. He is a crystallographer, and his application of this science in his stereochemical investigations has been of great importance. As a physical chemist he has contributed to our knowledge of surface energy, valency angles and the mechanism of the formation of heterocyclic ring systems. It can be confidently predicted that Prof. Bennett's tenure of the unique office of Government Chemist will be distinguished from all points of view; he has a ripe experience not only of many branches of his subject but also a wide knowledge of men and affairs.

Chair of Chemical Pathology, University College Hospital Medical School: Prof. C. Rimington

DR. RIMINGTON, former scholar of Emmanuel College, Cambridge, has been appointed to the chair of chemical pathology at University College Hospital Medical School. After a distinguished career in Sir Frederick Gowland Hopkins' laboratory at Cambridge, he organized the Biochemical Research Department of the Wool Industries Research Association at Leeds, and then for six years held a senior research fellowship of the Empire Marketing Board at the Onderstepoort Veterinary Research Laboratory in South Africa. In 1927 he was appointed to the staff of the National Institute for Medical Research, Hampstead.

Dr. Rimington's work has covered many fields of biochemistry, proteins, plant poisons and porphyrins,

to each of which he has made noteworthy contributions. In the field of protein chemistry he enlarged our knowledge of the phosphoric acid esters present in casein and of the serum glycoproteins; and latterly with his colleague, I. W. Rowlands, he has turned his attention with outstanding success to the important glycoprotein, gonadotrophin of pregnant mares' serum, a problem of great veterinary interest. During his stay in South Africa, Dr. Rimington worked on the constituents of plants poisonous to stock and from this made an incursion with J. I. Quin into the photosensitization of animals by phylloerythrin. With P. J. Fourie he discovered the first living cases of congenital porphyria in animals, and this has led to numerous contributions to the porphyrin field of pigment metabolism, on which he is an acknowledged authority. Without doubt Dr. Rimington will be received with welcome at University College Hospital Medical School, for his capacity for collaboration has been a valuable and invariable asset.

Geological Society Awards

THE Council of the Geological Society has made the following awards: Wollaston Medal to Prof. O. T. Jones, emeritus professor of geology in the University of Cambridge, for outstanding contributions to knowledge concerning the stratigraphy of Lower Palæozoic sedimentary rocks of Wales; Murchison Medal to Dr. W. Campbell Smith, keeper of minerals in the British Museum (Natural History), for his work on petrology and mineralogy, and his long service as secretary to the Society; Lyell Medal to Dr. L. F. Spath, of the Geological Department of the British Museum (Natural History), who is the foremost expert on the Ammonoidea and on the classification and evolution of the Cephalopoda; Bigsby Medal to Prof. L. R. Wager, of the University of Durham, for his outstanding researches, mainly in petrology, on East Greenland, the Sikkim Himalaya and the north of England; Prestwich Medal to Mr. A. S. Kennard, for his studies of Pleistocene faunas particularly of the non-marine mollusca; Wollaston Fund to Dr. D. R. Grantham, for his work on the Geological Surveys of Tanganyika and British Guiana, especially in the field of mining geology; Murchison Fund to Dr. W. A. Deer, for his researches on rock-forming minerals and petrology, especially of Scottish rocks; and his contribution to the description of the layered intrusion at Kangerdlugssuak in Greenland; one moiety of the Lyell Fund to Mr. A. H. Taitt, of the Anglo-Iranian Oil Company, Ltd., for his work on the exploration for oil in Great Britain, especially on the Nottinghamshire oilfield; another moiety of the Lyell Fund to Dr. F. B. A. Welch, of the Geological Survey of Great Britain, for his additions to our knowledge of the geology of south-west England, both above and below the Mesozoic unconformity, especially in relation to the complicated structures of the Mendips.

Display and Bower Building in Bower Birds

THE annual cycle of display and bower building by *Ptilinorhynchus violaceus* Vieill, the satin bower bird, was discussed in *Nature*, 153, 685 (June 3, 1944), by A. J. Marshall. He stated that this cycle is possibly due to the effect of increasing light and that stimuli from the bower act "through the anterior pituitary" upon the gonads. The selection of coloured decorations by the male matches the epigamic colours of the female and may "serve the function of exciting himself by their resemblance to female colours". It is regrettable that Marshall omitted reference to published work on these lines when mentioning investigations carried out during 1939–41. In "A Contribution to the Biology of the Satin Bower-bird" (*Australian Zoologist*, 10, 95; 1941), E. Nubling considerably antedates Marshall's conclusions and in some points differs from them. Nubling found that the bower building is not associated with increasing light, for during 1922–26 he found new bowers principally erected in May and June during decreasing light, and states that in such circumstances the whole proceeding of courtship and nidification fall into the period of decreasing light. Regarding the part played by the pituitary body, Nubling wrote (*loc. cit.*, 119), "the role of the pituitary in connection with such sexual manifestations as posturing during display or ceremonial is thus apparently a factor of outstanding importance", and he quoted the opinion of F. H. A. Marshall (1929) that sexual posturing in birds exercises a stimulating influence upon the anterior lobe of the pituitary.

Nubling discussed the selection of colours very fully in 1941, and so long ago as 1924 had submitted conclusions which were published by Dr. Casey A. Wood (*Amer. J. Ophthal.*, 8, 120; 1925), as follows: "Nubling's preliminary experiments made with colored disks . . . I shall now report in his own words. '1. Violet, indigo, blue. Any of these colours is collected by these birds, as well as any hue or tint thereof, *without any discrimination*. . . . 2. All the other colours collected correspond to those of the plumage, bill, legs, etc., of the immature male and the female, whose plumage is identical. On this I am almost positive, and many comparisons made, using Ridgway's Color Standards for the purpose, have borne out my contention' ". Wood points out that the irides of the female are of an even stronger blue than those of her mate. In 1941 Nubling wrote again (*loc. cit.*, 117) that the "decorations are not collected for the sake of their brightness, but for their colours . . . they represent the insignia, so to speak, of his female mate. The presence at the bower of objects bearing her colours is then not so much for the purpose of attracting the female, but for his own stimulation; they act on him in the way of an aphrodisiac". Nubling compared the exciting colours with Ridgway's 1912 Colour Guide: it seems that the "lemon-yellow" mentioned by A. J. Marshall is so masked by grey that the resultant effect is erroneously described as lemon-yellow; it corresponds to Ridgway's "deep greyish olive", the colour of the upper surface of the female. This is produced by a structural effect, combined with superposed yellow lipochrome, the black plumage of the male giving a blue structural effect.

Health Problems in War-time

BRIGADIER-GENERAL J. S. SIMMONS (*Brit. Med. J.*, 572, Oct. 28, 1944), speaking at the seventy-third annual convention of the American Health Association at New York on health problems during the past year or so in Italy, Sicily and north-west Europe, said that the public health programme is being carried out by a very small number of American and British medical officers and that it was necessary to rely upon local medical men. The greatest problems so far had been typhoid fever, dysentery, typhus fever, smallpox, malaria, venereal disease and scabies. In Italy and north-west Europe the incidence of typhoid

and paratyphoid fever rose after the military operations, but outbreaks had been limited to relatively few communities. The peak was reached in January 1944, when more than a million new cases were reported; but the outbreak was controlled so quickly that only 39 cases were reported during the last week of February 1944. Typhus had not yet been a problem in north-west Europe. Two outbreaks of smallpox had occurred in Italy, but none in north-west Europe. In February 1944, measures for the control of malaria were inaugurated in south and central Italy.

The United States War Department announced, on October 4, that tetanus had been virtually eliminated from the United States Armed Forces by compulsory immunization of all officers and men. No case had been reported among completely immunized troops, but a handful of cases had occurred when immunization had not been complete. Up to September 15, 1944, no cases had occurred in the United States Navy, which also requires compulsory immunization. Brigadier-General R. W. Bliss, assistant surgeon general, United States Army, said that, during a recent tour of the Pacific War theatre, he did not see one mosquito or fly. "When we first took over the Pacific Islands," he said, "there were clouds of insects everywhere, actually making it difficult to see. To-day, if we locate one mosquito, we consider it comparable to finding a four-leaf clover. To me, that's the outstanding achievement of medical science in this war." There were no malaria-carrying mosquitoes in Saipan, but there were species which carried dengue fever. After a few weeks of insect control, dengue fever, of which there had been a great many cases, practically disappeared. Medical sanitary companies divided the island into squares and drained and filled in swamps constantly. "The amazing D.D.T. insecticide, which did such a wonderful job in controlling typhus in Naples, was sprayed by hand and by planes."

Birds in Agriculture

DEFINITE evidence on bird behaviour is ever valuable, especially as regards agriculture, and Mr. A. Roebuck, of the Midland Agricultural College, has done well to put on record in the form of a leaflet five cases in which birds gave help to the farmer ("Birds in Agriculture." By A. Roebuck. Midland Agricultural College, Sutton Bonington). Rooks, lapwings and blackheaded gulls were the species that in these instances did much good work with regard to wireworms (*Agriotes obscurus*), dungbeetles (*Aphodius pinetarius* and *A. inquinatus*), leatherjackets (*Tipula paludosa*) and cutworms (*Agrotis segetum*). Of course, it has long been known that these birds take such agricultural pests, but here we have facts lucidly set forth that show how useful they are in the economy of the farm.

Empiricism and Descartes' Dream Situation

THE problem of determining the status of empirical propositions continues to exercise the minds and engross the attention of philosophers more than any other philosophical problem. The easy solutions of the logical positivists are being slowly torn to pieces by the more leisurely consideration of philosophers who, while sympathetic towards the general attempt to distinguish among propositions between the empirical sheep and the metaphysical goats, are yet suspicious of the ways of doing it. The attempt to find an empirical content for all genuine propositions gives rise to a number of problems. In the seventeenth century, Descartes had expressed the view that as the senses sometimes deceive, they *might* do so always. Therefore he concluded that he might be dreaming, no matter how wide awake he seemed to himself to be. Can one maintain this position without self-contradiction?

In a paper "On the Relation of some Empirical Propositions to their Evidence" (*Mind*, Oct. 1944), Mr. C. Lewy discusses whether it is self-contradictory to say that "I have all the evidence which I do have for saying that I am not now dreaming, and however many tests I may make in the future, they will all confirm this evidence, but I am now dreaming" (p. 289). The paper is long, subtle and difficult to follow. The point of the discussion, when reached, consists in the author's showing that the first part of the statement quoted makes the demand that all the evidence that turns up should be positive, whereas the second part demands at least one piece of negative evidence. There could not be a situation which fulfilled these two conditions. The author concludes not, as might be expected, that the statement is self-contradictory, but that to the question whether it is or not, no answer is possible.

Fixing Confidence Limits to Measurements

IN a paper read in London by H. J. Josephs before the Institution of Electrical Engineers on January 19, the author discusses the problems involved in the application of simple tests of significance to small sets of measurements. The paper opens with an account of the w-test, which applies to normally distributed variables, and this is followed by a description of the t-test, which is of particular use in dealing with a small number of observations. A method of rapidly applying this test is given, and it is shown that if the true mean value of a physical quantity is unknown, the confidence limits to be attached to an estimated value obtained from the measurements may be determined easily. A quick method is described of estimating the standard deviation of a set of measurements, and it is shown that for very small samples the extreme-mean or median forms a good alternative to the arithmetic mean and is often easier to calculate. Pearson's χ^2 test of goodness-of-fit is explained and illustrated, emphasis being placed on the flexible nature of this test and its relationship to the w-test. The elementary tests of significance described involve only a small amount of simple arithmetic, so that they enable an engineer to replace guesses or tentative estimates by well-founded probabilities, and to assess the reliability of some of his results. No mention is made in the paper of the design of large-scale experiments, for which these simple tests are of value in rapidly analysing the data obtained from preliminary trials.

Earth Tremor of December 30, 1944, in Britain

A CONSIDERABLE number of personal experiences of the earth tremor have now been received, and it appears that in some places the tremor reached intensity 5 on the modified Mercalli scale (*Nature*, Jan. 6, p. 15). In Yorkshire, the intensity was greatest in an elongated area near Skipton, and the only damage reported in this county was one chimney which developed a crack, possibly as the result of the shock, and had to be felled. An inquiry has

been made concerning possible sounds associated with the tremor, and three definite observations have been made, all supported by independent observation. (1) A rumble: typical observation by Dr. J. R. Ashworth, of Rochdale, who writes, "I heard a very audible rumble accompanying the swaying movement of the house". (2) A sound like a rushing wind, often said to have been followed by a thud, all taking place at the same time as the swaying. (3) No sound: this was the experience of many who felt the tremor and "knew it could not be bombs because there was no sound". So far, no systematic geographical distribution of the observations of the different types is apparent. In one area observations of all three types were reported. Miss E. F. Bellamy, of the University Observatory, Oxford, felt the earth tremor; but the seismograph at the Observatory was not working at the time. The tremor was not recorded on the disk of the Jagger shock recorder belonging to the British Association, then and now working at Comrie. The tentative reading of the record of the tremor obtained by Mr. E. W. Pollard at Binstead, Isle of Wight, shows that it recorded at 00h. 36m. 27s. G.M.T., and Mr. Pollard remarks that the record he obtained was similar to those resulting from "a tank passing at 100 yds., (2) a submarine depth charge at 5 miles, (3) the Burton explosion". No news has yet been received of any possible recordings by seismographs outside the British Isles.

Report of Seismological Investigations Committee

THIS Committee of the British Association has just issued its report for 1944. This is its forty-ninth report, and it first records with regret the death of Dr. F. J. W. Whipple, who was chairman of the Committee during 1931–39. It is remarked that Whipple was primarily responsible for the leading place which Kew took in seismology, and it was also due in no small measure to his interest, enthusiasm and skill that the International Seismology Summary (published at Oxford) received such generous support from the International Geodetic and Geophysical Union. During the year there has been no alteration in the location or working of the instruments belonging to the Committee which are out on loan. The Milne-Shaw seismographs are at Oxford, Cape Town, Perth (Western Australia), Edinburgh and Fiji. There is also a clock at Fiji and a Jagger shock recorder at Comrie. Thanks are expressed to the collaborators. Two complete recording units have been dispatched to Bombay, and three spare clocks to Poona. Four Milne-Shaw seismographs are under construction for Bombay. Under war conditions, the preparation and publication of the International Seismological Summary is the sole responsibility of Miss E. F. Bellamy of the University Observatory, Oxford. The first quarter for 1935 has been published and partially distributed, while the computation is complete to the end of July 1935.

Committee on Aids for the Deaf

IT has been announced in the House of Commons that the following committee has been appointed to advise and assist the Medical Research Council in promoting research into electro-acoustical problems relating to the design and application of instruments in alleviation of deafness: Dr. W. G. Radley (chairman), Mr. E. J. Barnes, Sir Lawrence Bragg, Mr. N. Fleming, Dr. C. S. Hallpike, Mr. L. C. Pocock and Dr. T. S. Littler (secretary). The Committee has formulated a detailed programme of research, and investigations in which physicists are collaborating with otologists and physiologists are in progress.

Linear Intercepts, Areas and Volumes

IN the two theorems stated by S. I. Tomkeieff in a communication under this title in *Nature* of January 6, p. 24, the word "by" was printed instead of "to". The theorems should read as follows:

"1. The average linear intercept of a convex polygon circumscribed to a circle is equal to the average linear intercept of the circle.

"2. The average linear intercept of a convex polyhedron circumscribed to a sphere is equal to the average linear intercept of the sphere."

The Night Sky in February

NEW moon occurs on Feb. 12d. 17h. 33m. U.T. and full moon on Feb. 27d. 00h. 07m. The following conjunctions with the moon take place: Feb. 1d. 03h., Jupiter 4° N.; Feb. 10d. 22h., Mars 0·1° S.; Feb. 15d. 20h., Venus 8° N.; Feb. 21d. 21h., Saturn 0·6° N.; Feb. 28d. 06h., Jupiter 3° S. The following occultations of stars brighter than magnitude 6 take place: Feb. 19d. 18h. 24·4m., δ Taur. (*D*); Feb. 19d. 19h. 14·2m., 64 Taur. (*D*); Feb. 19d. 20h. 09·6m., 68 Taur. (*D*); Feb. 23d. 2h. 36·8m., 63 Gemi. (*D*). The times refer to the latitude of Greenwich and *D* refers to disappearance. Mercury rises at 7h. 04m. at the beginning of the month and is not well placed for observation; on Feb. 28 the planet is in superior conjunction when it rises at 7h. 07m. Venus is an evening star and sets at 21h. 10m. and 21h. 53m. at the beginning and end of the month respectively. Mars is too close to the sun for favourable observation. Jupiter can be seen throughout the night, rising at 20h. 54m. and 18h. 48m. at the beginning and end of the month respectively. Saturn sets at 5h. 41m. on Feb. 1 and at 3h. 52m. on Feb. 28.

Announcements

PROF. HAROLD LASKI will deliver the first public lecture of the British Association of Chemists at the Caxton Hall, Westminster, on February 14, at 6.30 p.m. His subject will be "The Place of the Scientist in Post-War Administration". Anyone who is interested is invited to attend.

THE Maharaja of Travancore Lord Curzon Prize of the University of Madras has been awarded this year to Mr. S. Rajagopalan of the Indian Institute of Science, Bangalore, for his thesis "Essays in Chemotherapeutical Synthesis", representing the most meritorious original investigation in the physical sciences.

THE following appointments have recently been made in the Colonial Service: F. H. B. Blackburn, to be agricultural chemist, Barbados; J. V. Harbord, to be agricultural superintendent, British Guiana; T. E. Ryall, to be agricultural officer, Nigeria; J. B. Smart, to be assistant conservator of forests, Kenya; A. Jefferiss, to be chief fruit inspector, Palestine; W. J. Badcock, agricultural officer, Uganda, to be senior agricultural officer, British Solomon Islands Protectorate; W. H. B. Buckhurst, assistant director of lands, mines and surveys, Fiji, to be director of lands, mines and surveys, Fiji.

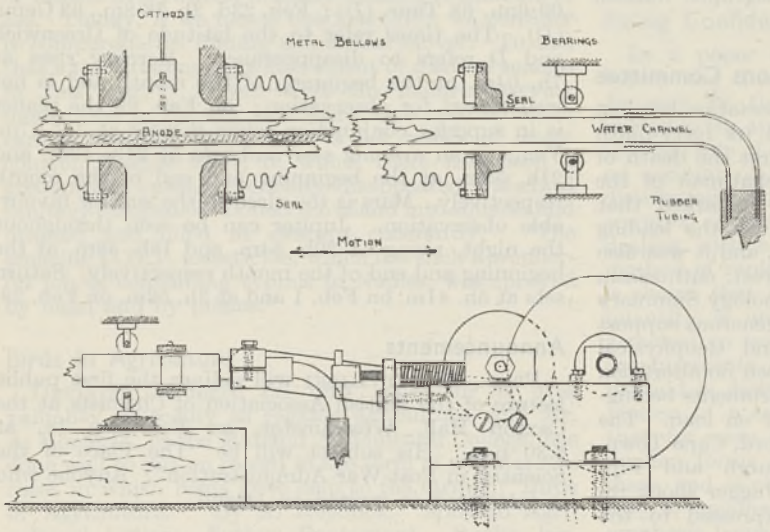
LETTERS TO THE EDITORS

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

A Simple Moving-Anode X-Ray Tube

THERE have now been described a number of moving-anode X-ray tubes, including the mercury-sealed type developed in this Laboratory[1-4], and their high performance may be regarded as established. They are, however, mostly expensive and not easy to build, and for the future welfare of X-ray structure analysis, particularly in the fibre and protein fields, something is needed for workers with modest resources—something that does not aim at the power that can be realized with a rotating anode, yet is considerably better than the stationary-anode tubes commonly in use. We have designed and constructed such a simple, demountable and inexpensive tube as follows.

The anode is a 5-ft. long horizontal copper tube, either of square cross-section or of circular cross-section with a plane surface in the central region, that is mounted on roller bearings at the two ends and oscillates with a stroke of 4 cm. at 3 complete oscillations per second. The vacuum is maintained by two lengths of metal bellows sealed on to the X-ray tube at their inner ends and on to the anode at their outer ends (see upper diagram). The drive is by means of a con-rod and wheel, belt-driven from a light Klaxon reduction gear; but to avoid repeated stationary points at the ends of the simple harmonic motion the axle of the wheel is also moved more slowly backwards and forwards over a ½-in. path by means of a friction drive against a cam (see lower diagram). The fast stream of water that passes along the central bore of the anode is admitted and taken away by pieces of stout rubber tubing at right angles to its length, so as to eliminate shaking by the oscillation. Also, to attain the speed and turbulence for efficient cooling, the bore at the focal-spot region is suitably constricted, for example, by a wooden insert.



This first model is admittedly experimental, and we envisage improvements in the near future as regards design of target, its distance from the X-ray windows, and neutralization of end-effects; but results obtained already are so gratifying that it is worth while quoting some of the principal dimensional features. The central flat of the anode is rather more than ½ in. across and its thickness with respect to the water flowing underneath is 2 mm. The metal bellows (the present pair were supplied by the Power Flexible Tubing Co., Ltd.) are each about 18 in. long and 2 in. external diameter, and so far they have oscillated for many hours without showing any signs of injury. (They are of the usual copper-zinc alloy, but we anticipate considerable advantages in elasticity and fatigue limit from the new copper-beryllium alloy that has recently been described[5]. Other seals are also possible.) The tube, of hot-cathode type (but, of course, moving anodes are equally applicable to gas tubes), incorporates two water-cooled windows (an important feature uncommon in rotating-anode tubes), an insulating body consisting of a miner's lamp glass as in the Shearer gas tube, and the tantalum filament, focusing cup and cathode already found advantageous in producing a sharp line-focus[3,4]. This line-focus (at right angles to the length of the anode) foreshortens, for an emergent beam at 6° to the horizontal, to an area effectively 0·75 mm. × 0·6 mm.; with such a focus we have run the tube at 44 ma. and 28 kV. and taken good photographs of ramie in 2 minutes at *D* 2 cm. with a ½ mm. slit.

The whole apparatus is remarkably quiet and unobtrusive: it may be mounted centrally along the usual laboratory bench with a spectrometer on each side and the pumping equipment immediately underneath. An adaptation that suggests itself is to have a single (longer) anode, sealed by a single pair of bellows, running through a series of X-ray tubes on the same bench; and it would be possible, too, to have a composite anode that included sections made from different metals. Two similar tubes, with a common anode and set at the requisite distance apart, might form an excellent arrangement for the purposes of high-speed stereoscopic radiography.

Full details will be published elsewhere. The junior author thanks the International Wool Secretariat for tenure of a research fellowship.

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I. MACARTHUR.

Textile Physics Laboratory,
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Dec. 12.

[1] Astbury and Preston, *Nature*, **133**, 460 (1934).
[2] Astbury, Meeting of X-Ray Analysis Group of Institute of Physics, Leeds, November 25, 1944.
[3] Green, Ph.D. Thesis, University of Leeds (1938).
[4] MacArthur, *Electronic Eng.*, Pt. 1, 272 (Dec. 1944); Pt. 2, in the press. Meeting of X-Ray Analysis Group of Institute of Physics, Leeds, November 25, 1944.
[5] Hunt, *J. Sci. Instr.*, **21**, 97 (1944).

Nuclear Histone from Bird Erythrocytes in the Preparation of Insoluble Insulin Compounds

FOLLOWING early work done in these laboratories on the use of thymus histone for the preparation of a histone-zinc-insulin with prolonged hypoglycæmic activity[1], we have now tried a histone from the nucleus of bird erythrocytes.

Drs. Lajmanovich and Mittelman directed our attention to this protein; it is usually classified as a histone, but they found in some reactions that it shows some properties of the protamines. We thank them for preparing the histone we employed, from turkey erythrocytes, by a modification of the method of Kossel[2].

A suspension of histone-zinc-insulin (histone from erythrocytes), at *p*H 6·8, and containing 40 I.U. insulin per c.c., was prepared by the usual procedure.

When administered to diabetic dogs, a fall in the blood glucose took place that lasted for a little more than twenty-four hours, when the initial glycæmic value was again obtained.

The type of glycæmic curve (glycæmia-hours) was similar to that obtained when the same amount of protamine-zinc-insulin (protamine-salmin) was administered. The hypoglycæmic action of the same amount of histone-zinc-insulin (thymus histone) was never so prolonged.

In conclusion, it can be stated that the histone-zinc-insulin complex prepared with histone from the nucleus of turkey erythrocytes has a hypoglycæmic activity more like that of protamine-zinc-insulin than that of the thymus histone-zinc-insulin preparation.

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Buenos Aires. Nov. 6.

[1] Biasotti, Deulofeu and Mendive, *Nature*, **138**, 1101 (1936). Biasotti, Deulofeu, Mendive and Patalano, *Medicina*, **3**, 442 (1943).
[2] Lajmanovich and Mittelman, *Rev. Inst. Bact.*, **12**, 320 (1944).

Detection of Chemotherapeutics in Thin Sections of Tissue by the Aid of Fluorescence Microscopy

IT has long been known that, thanks to their property of showing fluorescence in ultra-violet light, certain substances can be demonstrated even in very low concentrations. As a large number of the common drugs show fluorescence, it would appear reasonable to endeavour to demonstrate their presence also in tissues by the aid of fluorescence microscopy. The method has not been used very greatly, however, in view of the fact that the natural fluorescence of the tissues is so strongly blue that it masks the fluorescence of the drugs administered. In addition, the histological methods used have not excluded the possibility of changes in the locality and concentration of the substance sought during the actual preparation.

I have therefore adopted Altmann-Gersh's freezing-drying method for fixing and drying the sections, in doing which I have made use of a modification which has recently been described in detail by F. Sjöstrand[1]. The principle is as follows. The organs and pieces of tissue to be studied are removed and immediately frozen in liquid air. They are then dried over phosphorus pentoxide *in vacuo* in a refrigerator at about − 40° C. They are embedded in paraffin and cut into histological sections, which are mounted on slides, and are then ready for microscopical examination.

Drugs of which the fluorescence colour is other than blue can be demonstrated directly in the sections. For example, Prontosil rubrum and soluble, which have a strong red fluorescence, can be demonstrated[2] even in a concentration of 1×10^{-10} γ per μ^3, which is a considerably greater sensitivity than that obtained by observing the natural colour in an ordinary light microscope.

Drugs with blue fluorescence can frequently be made to change their fluorescence colour by heating in a small electric oven to different temperatures for different lengths of time. Sulphathiazole, for example, turns yellow on being heated to 170° C. for 5 minutes, the tissue itself remaining blue. This produces a beautiful contrast, allowing of the location of sulphathiazole in tissues and cells. In an ordinary light microscope, no traces of sulphathiazole can be discovered in such sections, any more than is possible in a fluorescence microscope before heating.

By the aid of this method it is possible to demonstrate the presence of a number of drugs, for example, sulphanilamide, sulphapyridine, papaverine, inulin (yellow after 3 min. at 200° C., the tissues still being blue), etc. Penicillin, which has a green fluorescence, can be identified without difficulty in muscle after an intramuscular injection and after the sections have been heated to 175° C. for 5 min.; the penicillin is then yellow-brown. In some cases the contrasts are obtained by the substance sought keeping its colour, while the tissues change their fluorescence colour. Sodium salicylate, which has a blue fluorescence, can thus be demonstrated at 200° C. after 5 min., the tissues at that temperature being yellow.

As the natural fluorescence is considerably differentiated, no special staining is necessary to facilitate the identification of the tissues.

By the aid of this method it has proved possible to study in detail the location of chemotherapeutic substances in tissues and their secretion.

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[1] Sjöstrand, F., "Über die Eigenfluorescenz tierischer Gewebe mit besonderer Berücksichtigung der Säugetierniere" (Stockholm, 1944).
[2] Helander, S., "Nachweis von Prontosil solubile in histologischen Gewebsschnitten mit Hilfe der Fluorescenzmikroskopie", *Acta phys. Scand.* (1944).

Detection and Determination of Traces of Methyl Bromide

METHYL bromide has many advantages as a fumigant, but suffers from the disadvantage that, over a range of concentrations liable to be encountered during airing, it is harmful to man and not detectable by smell.

The current method of detection, which does not serve for determination, depends on the appearance of a green 'copper' colour in the flame of a Halide detector lamp. This method is, of course, not specific to bromide and is inconvenient under many practical

conditions. A method free from some of these objections has now been devised. It depends on the catalytic combustion of traces of methyl bromide in air on a glowing platinum wire and the determination of the bromine liberated by the coloration of a test paper. The paper is wetted with a pale yellow solution of fluorescein, more or less of which is changed to red eosin according to the amount of methyl bromide decomposed. The apparatus, which is portable, consists of a vertical glass tube towards the bottom of which is mounted a platinum spiral which can be caused to glow by the passage of a current from a small 4-volt cell. The test paper, which is perforated in the middle, is fastened over the top end of the tube. When the current is switched on, a stream of air passes over the spiral and up the tube, which acts as a chimney, and the eosin, which appears as a ring on the paper surrounded by a white border, can readily be matched against standard disks.

By using different periods of testing and different colour standards, determinations of traces of methyl bromide can readily be made over a wide range of concentrations covering those which are of toxicological importance.

A fuller account of this method is being published elsewhere.

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Extraction of Phospholipids in Salmon Roe

IN the course of investigations on salmon roe globulin, the interesting observation was made that the phospholipids in the roe are so strongly held by the proteins that non-polar or semi-polar solvents with a low boiling point (pentane, light petroleum, ethyl ether) do not extract any phospholipid at all from salmon roe, which was previously dried at a temperature below 40° C., although the oil can be completely extracted by such solvents.

It was found by Hoppe-Seyler[1] and others that egg yolk lecithin and phospholipids from other sources are partly extractable with light petroleum or ethyl ether, but that their complete removal could only be accomplished by using a polar solvent such as methyl or ethyl alcohol. In no case, however, did he obtain a complete separation of the oil from the phospholipids. Only milk phospholipids have been reported to differ in this respect. Osborne and Wakeman[2,3] found that the phospholipids of milk precipitated together with the proteins were not extracted at all by ethyl ether, although a subsequent treatment with alcohol removed a considerable amount. These authors stated that the non-protein-containing fraction of milk contains phosphorus. Such findings are understandable for milk, which contains only about 27 mgm. of phospholipids per litre, but it was surprising to find no phospholipids in the solvent-extracted oil from salmon roe, while a subsequent extraction with alcohol removed on the average 6 per cent phospholipids. This is about 2,000 times the amount found in milk.

Experiments with salmon roe were as follows: fresh salmon roe was dried at 30° C. in the stream of air from a fan. The dried material was ground to 20-30 mesh and extracted with pentane in a Soxhlet apparatus. The oil obtained by this method contained the pigments; but no phosphorus, as shown by ashing and testing with ammonium molybdate.

The pentane-extracted roe was reground to 50–80 mesh, and thoroughly extracted with methanol in the same Soxhlet apparatus. The phospholipids so obtained had a reddish-brown, waxy appearance and a characteristic odour. They were free from oil. The ash content was about 10 per cent, the phosphorus content between 2·9 and 3·4 per cent, the moisture content 3–5 per cent.

On the average, the roe from sockeye salmon (*Oncorhynchus nerka*) yielded by the above method 12·5 per cent oil and 6·2 per cent phospholipids.

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[1] Hoppe-Seyler, T., *Hoppe-Seyler Med. Chem. Unters.*, **3**, 392 (1867).
[2] Osborne, T. B., and Wakeman, *J. Biol. Chem.*, **21**, 539 (1915).
[3] Osborne, T. B., and Wakeman, *J. Biol. Chem.*, **23**, 1 (1916).

Apparent Clearing of the Sky at Dusk

CLOUDS may disappear by evaporation of the droplets, a purely physical effect, but they may also vanish to the eye, though in fact they remain. It is generally accepted that the eye can distinguish between brightnesses down to the limit of 2 per cent difference, which may be termed the discrimination factor. The best papers on this factor and its variation with intensity are those of Nutting[1] and Hecht[2]. In average daylight for good eyes, the factor may be as low as 1 per cent, increasing for very bright light to about 6 per cent, and for much-reduced illumination rising steeply to more than 60 per cent; but the value 2 per cent holds approximately over a wide range of daylight.

This variation gives the explanation of 'the moonlight effect', since in shadows the general illumination is so low that the discrimination factor rises beyond the difference between adjacent objects which in daylight were distinguishable. Precisely the same explanation holds good in the sky, where differences recognizable in daylight disappear in reduced light in which discrimination may require a 5, 10 or 20 per cent difference. For example, Hewson[3] has calculated that radiation from a source at 25° zenith distance is reduced by 6·6 per cent in intensity in passing through 20 metres of cloud having droplets of 10μ diameter and a droplet water content of 0·1 gm. per cubic metre, as in high cloud. The loss is due to reflexion, absorption being negligible for daylight. Against a dark sky such a cloud is therefore visible until the discrimination factor approaches 7 per cent, which occurs when sky brightness is about 0·01 millilambert, shortly before the end of civil twilight. A similar cloud 200 m. thick reflects approximately 40 per cent, and ceases to be discriminated when the brightness is reduced to 0·0003 millilamberts, namely, about the end of nautical twilight.

There is also another factor tending to lessen the visibility of clouds at dusk. A cloud appears white against the blue sky because the latter scatters light predominantly blue and the former reflects or scatters white light from the sun. But when the sun is well down, clouds are illuminated only by scattered sunlight and starlight. They thus approach more closely to blue—the spectral region to which our dark-

adapted eyes are more sensitive. This lessening of colour difference has a considerable effect in reducing contrast, as may be seen by viewing a sky with scattered broken cloud through a blue glass. Viewing through an orange or light-red glass increases contrast. With a deep-red glass, however, the discrimination factor may be raised and so again contrast difference is reduced.

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Nov. 27.

[1] Nutting, P. G., *Trans. Illum. Eng. Soc., N.Y.*, **11**, 939 (1916).
[2] Hecht, S., *J. Gen. Physiol.*, **11**, 255 (1928).
[3] Hewson, E. W., *Quart. J. Roy. Met. Soc.*, **69**, 47 (1943).

Causality or Indeterminism ?

IN *Nature* of November 25, Prof. E. T. Whittaker says "If a coin is tossed a thousand times and the number of occurrences of heads recorded, and if this experiment is repeated a very great number of times, there will be a statistical regularity in the records, which may be calculated by the ordinary theory of probability. Does the calculation . . . involve only the assumption (as regards the tossing) that there is symmetry in the system".

Does this not assume that the hand—or machine—which tosses the coin moves in a 'random' manner. Such an assumption is often made, and the result quoted as if it were an axiom. Is there, in fact, any scientific reason for it ? Would not the hand—or the machine—tend to move in a systematic manner and thus produce a biased result if the action were repeated many thousands of times ? The assumption of symmetry appears to be a condition of the experiment yielding the hypothesized result ; it is clearly not justified by examination of the ordinary coin a human tosses—which is asymmetric—necessarily so if it is to achieve the purpose for which it is tossed.

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IN *Nature* of November 25 there is a letter from Mr. W. W. Barkas together with Prof. E. T. Whittaker's answer, concerning determinism. The reply refers *inter alia* to some experiment, which is apparently very famous, as during the last century nearly every book or treatise devoted to probability cites, describes or refers to, the so-called experiment of tossing a coin, or dice, etc. However, I have some doubts if any of the authors referring to this 'experiment' ever attempted to treat it as an experiment, that is, to repeat it.

As I have done so, although under somewhat improvised conditions, I would like to mention the results obtained, as they may be of interest to someone else.

I designed a simple device, by which the chosen coin, in fact, a new sixpenny piece, can be placed always in the same relation to the apparatus. A mechanically operated lever tosses the coin upwards a rather small distance with the same pressure exerted in the same period of time and on the same portion of coin, when tossed. The coin falls on a wooden surface covered with cloth, namely, an ordinary writing-desk. Before reaching the desk, the coin revolves several times in the air and after touching the surface it rebounds, as may be expected. The results : after tossing the coin a hundred times with head initially up, it rested with head up ninety-eight times. After adjusting the lever to a slightly different pressure exerted in the next hundred tossings, also with head initially up, the coin fell with head up once only.

I cannot say I was astonished, as I expected such a result, but it seems to me that it proves that the 'chance' of occurrence of head in tossing a coin is simply the result of the force applied, and consequently this experiment has nothing to do with indeterminism in the sense implied by Prof. Whittaker. On the contrary, as the two or one exceptions in position in which the coin falls are obviously caused by slightly uneven pressure (in force and duration) exerted by the rather improvised device, the experiment, after being repeated under strictly controlled conditions, is more likely to be used by advocates of determinism.

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MR. BARKAS in his letter in *Nature* of November 25 says, "My difficulty is that if the final result of, say, one million, or billion, photons is regular (that is, determined), then how can the choice of any . . . be individually indeterminate". I should like to point out that the final result is not strictly regular or determined. With increasing numbers of photons, the fluctuations about the mean become less and less proportionally significant, until, for many purposes, they can be left out of account. The same is true of the pressure of a gas. If we calculate the pressure from observations on a surface sufficiently large, then the fluctuations may be altogether inconsiderable and the pressure can be regarded as constant ; but if we take a surface sufficiently small—say, for example, a smoke particle—then the fluctuations will be large and will be the origin of the characteristic Brownian movement.

I should like to point out further that the argument Mr. Barkas quotes from the Guthrie Lecture cannot be sustained as disproving causality. What, under certain conditions, it does show is that causality fails if parameters are restricted to photons. Clearly, however, in the passage of photons through Iceland spar, parameters associated with the crystal lattice must be taken into account, and when this is done, the argument fails. Apparently von Neumann's argument has a similar weakness[1].

A large number of the facts of modern physics can be unified by means of non-causal laws ; but no case, so far as I know, has yet occurred where causal explanations can be ruled out as impossible. Natural phenomena, as we see them, may indeed permit of unifying descriptions from two totally different points of view. Perhaps, alas, both types of description may fail.

Determinism is probably not applicable outside material phenomena, but in regard to these it has proved a very useful philosophical principle for hundreds of years. Caution is therefore necessary before it is thought of as having 'collapsed'.

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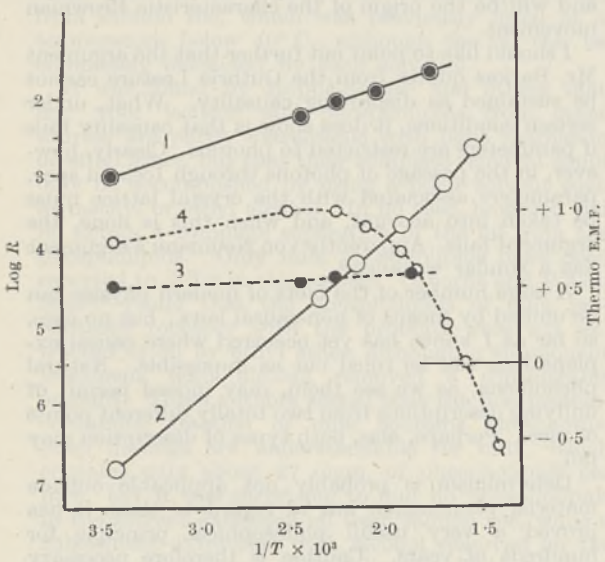
[1] Pelzer, *Proc. Phys. Soc.*, **56**, 195 (1944).

Semi-conducting Properties of Stannous Sulphide

IN a previous communication[1], we reported that two mechanisms are discernible in the electrical conductivity of stannous sulphide: positive-hole conduction, depending on the departure of the material from stoichiometric composition; and, at higher temperatures, a second mechanism with higher activation energy, fairly reproducible from one sample to another. This high-temperature conduction, we suggested, represents the intrinsic electronic conductivity of the crystal lattice.

We have recently obtained evidence confirming this view from simultaneous measurements, over a wide temperature range, of (*a*) the conductivity and (*b*) the thermo-electric effect of the couple gold – stannous sulphide – gold. At temperatures corresponding to the first leg of the log (conductivity) $-1/T$ curve, the direction of the thermo-electromotive force is indicative of positive-hole conduction (plotted as positive in the graph); its magnitude varies with the stoichiometric composition of the sulphide (0·5–0·6 millivolts per degree for well-conducting material, with activation energy of conduction 0·16 e.v.; 0·8–1·0 millivolts/degree for the same specimen after hydrogen treatment, with $E_1 = 0{\cdot}43$ e.v.), but varies little with temperature while only one conduction process is effectually operative. At temperatures approaching the discontinuity in the log conductivity $-1/T$ curve, the Seebeck electromotive force decreases, becoming negative at temperatures rather above the onset of the high-temperature conduction process (see graph). At high temperatures the current carriers are therefore electrons, and the activation energy of conduction can be regarded as the energy of excitation of an electron to the conduction band of the crystal.

Schottky and Waibel[2] observed an analogous change in the magnitude and sign of the Hall coefficient of cuprous oxide (also a positive-hole conductor at ordinary temperatures, due to the stoichiometric excess of oxygen) at temperatures near the break in the conductivity curve. The behaviour of stannous sulphide thus provides a second instance of the clear identification of the intrinsic conductivity of a semi-conductor.



Curve 1. LOG $R - 1/T$ CURVE FOR SUBLIMED STANNOUS SULPHIDE.
Curve 2. SAME, AFTER TREATMENT WITH HYDROGEN AT 250°.
Curve 3. THERMO-ELECTROMOTIVE FORCE – $1/T$ CURVE FOR SUBLIMED MATERIAL.
Curve 4. THERMO-ELECTROMOTIVE FORCE CURVE OF MATERIAL AFTER HYDROGEN TREATMENT.

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Oct. 5.

[1] *Nature*, **152**. 75 (1943); full account in course of publication.
[2] *Phys. Z.*, **36**, 912 (1935).

Serological Reactions Caused by the Rare Human Gene Rh_z

A RARE allelomorph of the *Rh* gene has been described[1,2] and provisionally denoted by Rh_y. This gene differs from the six *Rh* allelomorphs previously found in giving a negative reaction with γ serum, but at the same time a positive reaction with *H* serum. The Greek letters here used for the *Rh* antibodies are those suggested by Fisher[3], but various names have been used:

Γ = anti-Rh_1 (more recently anti-*Rh'*, Wiener) = rho_1 = serum 1 (Murray).
γ = *St* = serum 4.
Δ = standard 85 per cent reacting = *rho* = serum 3.
H = anti-Rh_2 (more recently anti-*Rh''*) = serum 2.

The reactions of this allelomorph 'Rh_y' with the other two antibodies Γ and Δ were unknown, since in the examples found it had as partner the gene Rh_1, which is itself positive with these two antibodies. Consequently the reaction of the rare gene *per se* was obscured.

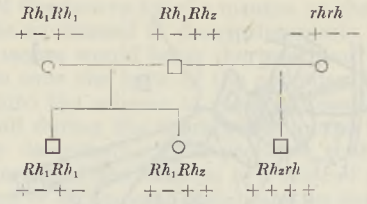
On theoretical grounds, Fisher[3] considered that there were probably two genes which were γ negative and *H* positive, and predicted that one would be Δ negative and the other Δ positive, and that both would be Γ positive. One he called Rh_y and the other Rh_z and assigned to them these reactions.

	Γ	γ	Δ	*H*
Rh_y	+	−	−	+
Rh_z	+	−	+	+

A family has recently been examined in which the father's blood was of the type γ negative *H* positive, which we would previously have called Rh_1Rh_y. The father was the second person in whom this rare gene was found. In a child by his second wife, the rare gene is caught in combination with *rh*, so that its reactions with Γ and Δ are no longer obscured but disclose themselves (for *rh* is negative with both these antibodies). The child's blood was Γ positive and Δ positive, so that the gene present is Fisher's Rh_z. Had the child got Rh_1 from its father its cells would have been negative with *H*, for Rh_1rh is + + + −.

Fisher's main hypothesis gains some support since it demanded that neither Rh_z nor Rh_y would be Γ negative. If later this theory is fully substantiated, the symbols Rh_y and Rh_z will be equivalent to the antigenic formulæ *CdE* and *CDE*.

In previous communications[1,2,4], certain bloods have been called genotype Rh_1Rh_y; they may have been Rh_1Rh_y or Rh_1Rh_z. In the family here described,



(Order of sera, Γ γ Δ *H*. This is not the order used in some earlier communications, which was Δ γ *H* Γ.)

alone of four families examined, has the rare gene segregated in such a way that its reaction with all four antibodies could be determined; they have turned out to be those proposed by Fisher for Rh_z. The proof of the existence of Rh_y as an eighth gene will probably have to await an equally fortunate segregation.

The scheme previously published[3] is here given again with the necessary alterations.

Genes		Γ	γ	Δ	*H*
Rh_z	*CDE*	+	−	+	+
Rh_1	*CDe*	+	−	+	−
Rh_y	*CdE*	(+)	(−)	(−)	(+)
Rh'	*Cde*	+	−	−	−
Rh_2	*cDE*	−	+	+	+
Rh_0	*cDe*	−	+	+	−
Rh''	*cdE*	−	+	−	+
rh	*cde*	−	+	−	−

Those reactions not yet determined serologically are given in brackets.

Sera of the Γ, Δ and *H* types, kindly sent from America by Dr. A. S. Wiener, gave with the bloods of this family the same reactions as our sera.

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[1] Race, Taylor, Boorman and Dodd, *Nature*, **152**, 563 (1943).
[2] Race, Taylor, Cappell and McFarlane, *Nature*, **153**, 52 (1944).
[3] Race, *Nature*, **153**, 771 (1944).
[4] Race and Taylor, *Nature*, **153**, 560 (1944).

Devernalization by High Temperature

THE possibility of devernalization by high temperature was demonstrated in previous work[1]; but the aim then was to show that it is low temperature rather than restriction of growth which is the determining factor in vernalization. To separate these factors, anaerobic conditions were imposed during the period of high-temperature treatment, and misconceptions have arisen as to the validity of the results on this ground[2,3,4].

Interest in devernalization has led to further work in the U.S.S.R. by Efeikin and by Tetjurev. The former[5] showed that 45 days of vernalization in winter wheat ('Durable') may be annulled completely by 4–5 days at 34–35° C., while one day's exposure to this temperature reduced ear production to 66 per cent of that of the vernalized but unheated controls. Similar results were obtained by Tetjurev[6].

The devernalizing effect of high temperature has been confirmed by us. Winter rye (var. *Petkus*) was vernalized for 42 days at 1° C. and then the seed was subjected to a range of temperatures for varying periods of time. The temperatures used were 25°, 30°, 35° and 40° C., and the durations of heat treatment were 8 and 16 hours, 1, 2, 3, 4, 5, 6 and 10 days. The full details will be presented later; here the results for 35° only are given.

TABLE 1. EFFECT OF TREATMENT AT 35° C. BEFORE SOWING ON THE RATE OF EAR DEVELOPMENT (1) IN WINTER RYE VERNALIZED 42 DAYS AT 1° C., AND (2) IN SPRING RYE.

Duration of heat treatment	Spring rye (unvernalized)		Winter rye (vernalized)	
	'Score'	No. of replicates	'Score'	No. of replicates
0 (Controls)	123 ± 0·12	(52)	100 ± 3·0	(47)
8 hours	120 ± 0·77	(48)	95 ± 4·6	(44)
16 ,,	121 ± 0·93	(53)	90 ± 4·9	(35)
1 day	120 ± 0·65	(62)	75 ± 6·5	(35)
2 days	121 ± 0·68	(47)	80 ± 5·9	(39)
3 ,,	124 ± 0·40	(55)	72 ± 9·5	(16)
4 ,,	123 ± 0·46	(49)	72 ± 6·4	(33)
5 ,,	120 ± 0·64	(42)	63 ± 6·6	(35)

Spring rye (var. *Petkus*) was subjected to similar heat treatments without previous low-temperature treatment. The results obtained are entered in Table 1.

The values entered in the Table are means of 'scores' assigned to the individual plants to denote the stage of development reached by the ears at the end of the experiment; the higher the value the more advanced the ear. The method of scoring is discussed elsewhere'. A score of less than 50 denotes a stage between an undifferentiated stem apex and the dehiscence of the anthers, and is determined by dissection of the main axis of the plant: values above 50 denote, by difference from the numbers entered, the number of days elapsed after the ear has passed beyond the stage of anthesis. The entries enclosed in brackets are the number of replicates on which the mean value is based. The score attained in this experiment by unvernalized winter rye was 22 ± 0·63 with 40 replications.

The following conclusions may be drawn. (1) Heat treatment of the seed is without effect on the flowering behaviour of spring rye. This shows that there is no question of a lethal action concerned. Spring rye heated at 40° C. for 4 days scored 120, thus substantially the same as at 35° C. It may therefore be assumed that the reduction in score seen in winter rye is not due to any injury effect. (2) A progressive reduction in the score accompanies prolonged heat treatment of winter rye, and the downward trend is statistically significant. The delay in flowering is then, presumably, due to the reversal of the vernalization effect. It is interesting to note that in these experiments no complete devernalization occurred. After treatment at 40° C. for 2 days the score was 79 ± 8·0, that is, four times that of unvernalized winter rye, whereas a further day at 40° C. killed all the seed.

Further proof that the delay in flowering noted

TABLE 2. REVERNALIZATION OF WINTER RYE, AFTER HEAT TREATMENT, BY A FURTHER PERIOD OF 6 WEEKS AT 1° C.

Duration of heat treatment	'Score'	No. of replicates
0 (Controls vernalized 12 continuous weeks at 1° C.)	112 ± 1·18	(17)
8 hours	113 ± 0·95	(48)
16 ,,	117 ± 0·82	(41)
1 day	117 ± 0·45	(42)
2 days	113 ± 0·93	(39)
3 ,,	118 ± 0·65	(54)
4 ,,	117 ± 0·63	(54)
5 ,,	116 ± 0·65	(55)

was a true reversal of vernalization was provided by the following experiment. After the preliminary vernalization for 42 days at 1° C., and the following heat treatment for varying durations and temperatures, the seeds were exposed to low temperature for a further six weeks, thus receiving in all twelve weeks at 1° C. The effect on ear development is shown by the scores given in Table 2.

The scores are thus slightly higher than those of the control series which had been vernalized for an unbroken period of twelve weeks. The absence of any effect of heat treatment on spring rye, and the possibility of revernalization by low temperature after the heat treatment, proves beyond doubt the possibility of reversing the normal vernalization process.

An interesting effect noted in the course of this work is that the efficacy of the high-temperature treatment in reversing vernalization depends upon the duration of the previous low-temperature period, and thus upon the 'intensity' of vernalization. This aspect is now the subject of further investigation.

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Dec. 14.

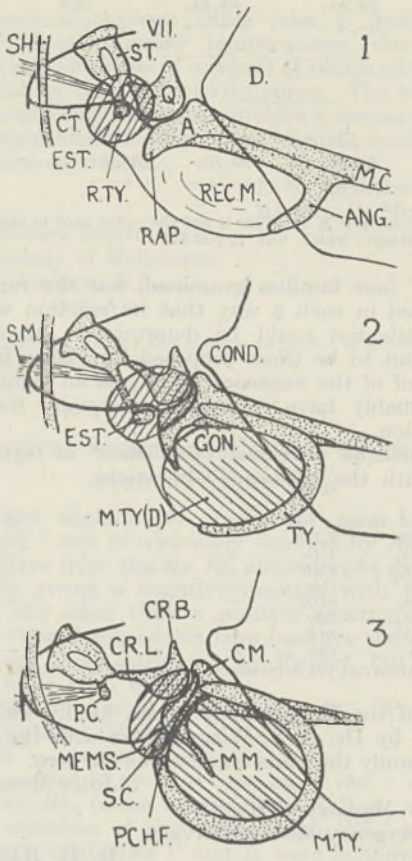
[1] Gregory, F. G., and Purvis, O. N., *Ann. Bot.*, N.S., **2**, 753 (1938).
[2] Whyte, R. O., *Biol. Rev.*, **14**, 51 (1939).
[3] M. A. O., *Herb. Rev.*, **8**, 83 (1940).
[4] Bassarskaya, M. A., and Grossman, V., Ju., *Herb. Abstr. Suppl.* II, 11, 11 (1941).
[5] Efeikin, A. K., *C.R. Acad. Sci. U.S.S.R.*, **30** (7), 661 (1941).
[6] Tetjurev, V. A., *C.R. Acad. Sci. U.S.S.R.*, **30** (2), 189 (1940).
[7] Gregory, F. G., and Purvis, O. N., *Ann. Bot.* N.S., **2**, 237 (1938).

The Mammalian Middle Ear

IN a recent communication in *Nature*[1], certain implications of new work on the anatomy of the middle ear region of mammal-like reptiles were discussed. Some further aspects of the evolution of the mammalian middle ear are here briefly noticed. A new synthesis, based on palæontological evidence, was recently offered[2] to 'explain' the nature of the mammalian tympanic cavity. It was suggested that the primitive reptilian tympanic cavity was, in at least some therapsids, supplemented by a recessus mandibularis related to the region of the notched angular bone; and that the mammalian tympanic membrane was formed from the thin external wall of this recess by extension of the old tympanic membrane.

A feature of the mammalian tympanic region, not found in living 'lower' tetrapods, is the presence of the membrana Shrapnelli, or 'pars flaccida' of the tympanic membrane. As pointed out long ago (reviewed by Bondy[3]), this structure is not really part of the tympanic membrane, from which it is separated in the human subject by the anterior and posterior malleolar folds, which are variously developed in other mammals (the anterior and posterior "Chordafalten" of Bondy). So far as I am aware, Shrapnell's membrane and the *Chordafalten* have never been adequately discussed from the phylogenetic point of view. In the earlier work[2] they were not discussed, but they can be shown to fall clearly into place and to modify some of the details previously set forth.

Shrapnell's membrane seems with great probability to represent the remains of the 'reptilian'



Three suggested stages (diagrammatic) in the evolution of the mammalian middle ear from an advanced theriodont (a cynodont). *A.*, articular; *ANG.*, angular; *C.M.*, caput mallei; *COND.*, condyle of dentary; *CR.B.*, crus brevis; *CR.L.*, crus longus; *CT.*, chorda tympani; *D.*, dentary; *E.ST.*, distal part of extrastapes; *GON.*, gonial; *M.C.*, Meckel's cartilage; *M.E.M.S.*, membrana Shrapnelli; *M.M.*, manubrium mallei; *M.TY.*, mammalian tympanum; *M.TY.(D.)*, developing mammalian tympanum; *P.C.*, Paauw's cartilage; *P.C.H.F.*, posterior "Chordafalte"; *Q.*, quadrate (incus of mammals); *RAP.*, retro-articular process; *REC.M.*, recessus mandibularis; *R.TY.*, reptilian tympanum; *S.C.*, Spence's cartilage; *SH.*, stylohyal; *S.M.*, stapedial muscle; *ST.*, stapes; *TY.*, tympanic bone; *VII*, facial nerve.

tympanum of therapsids. Its relations to Spence's cartilage (which probably gives rise to Bondy's "Chordafortsatz"[3,4,5]) support the previous identification[1] of this element with the separated distal part of the extrastapedial. The course of the chorda tympani, allowing for the functional degeneracy of the extrastapedial, also favours this interpretation. Moreover, Shrapnell's membrane (in mammals where it forms part of the outer wall of the epitympanic recess), and the bony walls of that recess, have similar relations to those between the 'reptilian' tympanic membrane of some therapsids and the corresponding part of the bony skull, which differs considerably from the homologous region in living reptiles; the main difference is that Shrapnell's membrane normally extends forward to the anterior limb of the tympanic in mammals, and meets the malleus. This difference seems to be due to changes in proportions of the region of the old reptilian jaw articulation, and to slight lateral movement (relative to the articulation) of the 'reptilian' tympanum and external auditory meatus, during the transition to mammals. The latter is distinctly indicated by the

position of the groove for the meatus on the posterior face of the squamosal in many therapsids.

Such changes would bring the 'reptilian' tympanic membrane over the back of the articular. This also fits well into the scheme of regional plastic changes in the skull during the therapsid-mammal transition previously described[6]. It is probable that the processus lateralis of the malleus is a relic of an earlier attachment of a tympanic membrane on the articular—probably of the old reptilian tympanum at a stage when the dentalo-squamosal articulation had become the adult jaw articulation, so that the articular was relatively immobile.

The *Chordafalten* would then seem to be the reduced and compressed equivalent of the tissues which laterally separated the upper part of the tympanic cavity of therapsids from the recessus mandibularis. Their relations to the chorda tympani, to the malleus and goniale, to the tensor tympani and to the enlarged tympanic annulus, can readily be understood in this way (cf. Figs. 1–3). It should be noted that a compressed posterior *Chordafalte* would not result if a depressor mandibulæ muscle of ordinary reptilian ('sauropsid') type were present. But in the higher therapsids the 'loose' quadrate and the delicately built articular region make it clear that the jaw musculature cannot have been closely comparable with that in, for example, lizards. It seems probable that at least some of the more mammal-like reptiles had already some 'mammalian' characters in the muscles for opening the jaws. In monotremes this is done by the detrahens mandibulæ (a slip from the adductor externus group), while other mammals have developed a digastric (from the intermandibularis and interhyoideus musculature). This supports the suggestion that mammals are not monophyletic. Parallel evolution in higher therapsids is well known, and in many structures the trend is towards a mammalian pattern; Olson[7] has recently demonstrated several new and striking trends. If more than one therapsid stock gave rise to mammals, the great similarity in the tympanic membrane and related structures in all mammals suggests either a further example of very closely parallel evolution, or that, in at least some therapsids, the outer membranous wall of the recessus mandibularis had already assumed some kind of tympanic function.

The therapsid and sauropsid reptiles differ in so many ways that any advance in understanding of these problems can come only from palæontological evidence combined with a study of the anatomy (particularly developmental) of generalized mammals.

Finally, it should be noted that the accessory 'dermal' elements associated with the malleus may not be correctly homologized within the group. The ossiculum accessorium malleoli and the goniale need the most careful re-investigation, but their relations in *Chrysochloris* in particular support the tentative homologies previously suggested[1].

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Nov. 24.

[1] Westoll, T. S., *Nature*, **154**, 770 (1944).
[2] Westoll, T. S., *Proc. Roy. Soc.*, B, **131**, 393 (1943).
[3] Bondy, G., *Anat. Hefte*, I Abt. (Arb. Anatom. Inst), **35** (Heft 106), 293 (1907); **37** (Heft 113), 591 (1908).
[4] van der Klaauw, C. J., *Z. gesamte Anat.*, III Abt. (Ergebn. Anat. Entw.-Gesch.), **25**, 565 (1924).
[5] van der Klaauw, C. J., *Bull. Amer. Mus. Nat. Hist.*, **62**, 1 (1931).
[6] Parrington, F. R., and Westoll, T. S., *Phil. Trans.*, B, **230**, 305 (1940).
[7] Olson, E. C., *Geol. Soc. Amer.*, Spec. Pap., **55** (1944).

New Observations on *Uronema*

Uronema indicum growing as an epiphyte on aquatic plants in July at Allahabad, India, has been studied in natural as well as cultural conditions. In Nature the filaments were about 6 mm. long, but in culture they attained a length of 4·2 cm. The cells showed wide variations, even in Nature. Usually they were 14–19 μ long and 6–14 μ broad and had a chloroplast occupying the whole length of the cell. In many cases the cells, especially those near the tip, were much longer (40·3 μ) and had the chloroplast only in the middle. The size of the filament and cells and the extent of the chloroplast within the cell have been made the chief features for differentiating the various species of Uronema. The above observations show that such variations may also be due to ecological conditions.

No method by which *Uronema* perennates has so far been reported. This species was found to perennate by means of akinetes under both natural and cultural conditions. The akinetes were formed in Nature on desiccation or on approach of winter and in culture due to overcrowding or growth in continuous strong light. The akinetes had only a slightly thick ned wall and were single or more usually composed of a row of cells (Fig. 1). When put in tap water, even after three months the cells of the akinete (from both Nature and culture) began to elongate, thereby rupturing the wall which for a time remained attached to the end as H-pieces (Fig. 2). The terminal cell gradually became acuminate and the basal cell acquired a hyaline mucous pad for attachment (Fig. 3). Further growth and cell division resulted in a long filament.

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Origin of Viruses

IN recent times two abnormalities have arisen in the apple Lord Lambourne when this variety has been grafted on to certain other kinds: (1) where the branches and growth lack rigidity, so that the weight of even a few fruits pulls the branches almost vertically to the ground, (2) where the fruit only develops about a quarter of normal size. Thus when Lambourne has been grafted on to the variety Excelsior, Lambourne has developed non-rigid growth, and when grafted on to Redcoat Grieve it has developed the small-fruit abnormality. The same reactions have occurred in Lambourne when it has been grafted on to certain other kinds.

The behaviour of the abnormalities[1] suggests they are of the nature of viruses and that they have arisen directly by grafting, that is to say, by the invasion of the cells of one variety by the proteins of another. In some cases where the abnormalities have arisen three individuals have been grafted

together, therefore the possibility of all three taking part in the origin of the abnormalities cannot be ruled out.

Recently, Darlington[2] has recalled the work of Salaman and Le Pelley[3], who found the potato King Edward when grafted on to other varieties produces disease, and it seems probable that the Lord Lambourne abnormalities are of the same kind. These cases differ, however, in one respect. For in the potato, King Edward introduces something into the varieties with which it is grafted which is deleterious to them, whereas in the apple it is Lord Lambourne which alone has, so far, suffered from combinations with different varieties or stocks.

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Dec. 18.

[1] Crane, M. B., *The Grower*, **22**, 53 (1944).
[2] Darlington, C. D., *Nature*, **154**, 166 (1944).
[3] Salaman, R. N., and Le Pelley, R. H., *Proc. Roy. Soc.*, B, **106**, 140 (1930).

Fluorescence in Ultra-Violet Light as a Test for the Presence of Leaf Roll Virus in Potato Tubers

ON reading an article in the *School Science Review*[1], I recently became interested in the use of ultra-violet light as a possible means of detecting the virus responsible for potato leaf roll in the tubers of the plant.

Tubers were collected (including 'setts' where possible) from leaf rolled plants during late July and early August, and at the same time tubers were taken from healthy plants of the same varieties. After being cleaned they were examined under ultra-violet light from a 230 v. 125 amp. 3-pin base bulb fitted with a Wood's glass filter supplied, through Mr. Brennan, representative of the General Electric Co. in Belfast. Since no fluorescence was observed from the entire tubers—they assumed a light mauve colour, with the 'eyes' showing up as white areas—they were then cut transversely. The cut surfaces of the tubers from the leaf rolled plants then displayed varying amounts of fluorescence. This fluorescence was most marked in the 'setts', where it appeared to extend throughout the medulla (pith), but was more limited in its distribution in tubers of the present season's growth, where it appeared to be confined to the vascular bundles.

In comparison, cut tubers from healthy plants showed a much lighter colour on the cut surfaces than on the 'skin', but there was no sign of fluorescence—merely a lighter shade of the mauve colour referred to above.

Although the number of tubers examined was small, there appears to be every possibility that this test could be used with some degree of certainty in diagnosing the presence of the leaf roll virus in potato tubers, and the test has the advantage of being rapid. The cutting of the tubers can be carried out near the 'heel' end, and damage to the buds in the 'eyes' easily avoided.

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[1] Campbell, D. A., *School Sci. Rev.*, **25**, 278.

Wood-boring Insects in Beech Furniture

IN Mr. A. L. Howard's recent article[1] on "The Beech Tree" it is stated that "beech has been a favourite wood with chair-makers for 200 years and perhaps more. The higher class makers . . . generally used beech for the frame. . . . Many fine specimens of artistic design and clever craftsmanship have been lost, as the beech framework used was attacked by the *Lyctus* or *Xestobium* beetles, or both, the framework rapidly turning to dust, and the chairs breaking up."

Records of infestation of timbers by these insects have, however, shown that neither normally occurs in beech furniture. *Lyctus* powder-post beetles (family Lyctidæ) attack partly and recently seasoned sapwood of certain hardwoods such as oak, ash, elm, walnut, in which the vessel diameter is sufficient to accommodate the ovipositor of the female and in which the starch content of the wood is adequate for the nutrition of the larvæ. Neither of these conditions is fully fulfilled by beech, which is not liable to infestation by these insects.

Beech is not immune to attack by *Xestobium rufovillosum*, the death-watch beetle (family Anobiidæ); but this insect rarely occurs in furniture, although well known for its powers of destruction in roofing and other structural timbers, chiefly oak, when conditions are favourable for its development.

There are two insects, both belonging to the family Anobiidæ, which sometimes do cause serious damage to beech timber: the common furniture beetle (*Anobium punctatum*), the most frequent cause of 'worm' in old furniture, not only of beech but also of many other woods, including walnut; and, less commonly, *Ptilinus pectinicornis*, which also occurs in sycamore and willow. Of these, the common furniture beetle is by far the more important, and in the course of repairs to valuable furniture such as that mentioned by Mr. Howard, the use of a suitable preservative treatment for woods susceptible to attack by this insect is advisable to prevent a recurrence of the trouble.

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[1] *Nature*, **154**, 492 (1944).

Newton and His Portraits

I WRITE with reference to the note in *Nature* of January 13, on portraits of Newton. We have in this College a portrait of Newton painted by Henry Cooke in 1669, the year in which he became Lucasian professor. Newton was a benefactor of St. Catharine's College, lending money to erect the new buildings at that period, a loan which he later made a gift. We have no record of the circumstances in which the portrait was painted, but it shows him as a young man in a red gown with the open neck typical of his later portrait by Kneller.

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RESEARCH ITEMS

Myohæmoglobin and the Crush Syndrome

A COMMON type of air-raid casualty is the person who has remained trapped for several hours with a limb crushed or compressed beneath debris. Such patients, after their release and admission to hospital, frequently develop a characteristic set of symptoms which has been called the 'crush syndrome'. The most striking features of this condition, apart from surgical shock, are the excretion of myohæmoglobin in the urine and the onset of severe renal failure, which often ends in death from uræmia. Bywaters and Popjak (*Surg. Gynec. Obst.*, 75, 612; 1942) attempted to reproduce this condition in rabbits by experimental crushing or compression of the leg muscles. They found that surgical shock ensued as in man, but there was no myohæmoglobinuria and no renal damage. The absence of myohæmoglobinuria was readily explained by the finding that rabbit's muscles contain practically no myohæmoglobin, and the results naturally suggested that the renal damage which occurs in man might in some way be caused by the renal excretion of myohæmoglobin. Bywaters and Stead (*Quart. J. Exp. Physiol.*, 33, 53; 1944) have investigated this possibility and they find that while injection of myohæmoglobin into normal rabbits (with alkaline urine) does not damage the kidney, injection into rabbits with acid urine or into rabbits after limb crushing does produce severe kidney damage which may be fatal. It seems that in the crush syndrome both myohæmoglobin and various acid breakdown-products are liberated from the crushed muscle, and the excretion of myohæmoglobin in an acid urine is the main cause of the renal damage, though why myohæmoglobin should damage the kidney is not yet clear.

Pancreatic Extracts and Cell Growth *in vitro*

J. N. Davidson and C. Waymouth (*Quart. J. Exp. Physiol.*, 33, 19; 1944) have shown that a simple extract of pancreas (pancreatin) contains substances which influence the growth of chick heart fibroblasts *in vitro*. Two factors have so far been separated and they have been partially purified, but not completely so. One factor, which the authors consider may be lecithinase A, has a striking effect on the morphology of the cells in culture. Normal fibroblast cultures nourished with embryo extract present the appearance of a loose network of elongated cells with oval nuclei; under the influence of this pancreatic factor the appearance alters to one of closely packed polygonal cells with round nuclei. The second factor stimulates growth of the culture (as judged by the increase of nucleoprotein phosphorus), and its action seems to be similar to that of embryo extract. This factor probably comprises polypeptides and certain breakdown products of nucleic acids, substances which may well serve as raw materials for nucleoprotein synthesis. Trypsin and ribonuclease, though present in the crude extract, were absent from the fractions finally employed, and are therefore excluded.

Lower Jaw of Stegocephalia

THE Stegocephalia are generally regarded as the amphibian order that most nearly approaches the stem of the Reptilia, and consequently in them one is most likely to find morphological relationships that will help in understanding the conditions met with in reptiles. A comprehensive and comparative account of the lower jaw of the Stegocephalia is furnished by T. Nilsson (*Kungl. Svenska Vetensk. Akad. Hand.*, 21; 1944). The following homologies are suggested: the bone up to now regarded as the 'splenial' of the Stegocephalians is termed the presplenial, while that in the reptiles is probably the fusion of pre- and post-splenials; the posterior meckelian foramen is the posterior mylohyoid, the anterior meckelian is the anterior mylohyoid and the postsymphysial foramen is the lingual foramen of reptiles. Owing to the considerable amount of overlapping in the dermal bones their superficial outlines do not indicate accurately their extension at deeper levels. The foramina and canals in the bones of the jaw allow of an attempt at a restoration of the nerves and blood vessels, and on this certain new names of general application are proposed for them. In considering the veins it is suggested that there were in the head of the Stegocephalian a series of sinuses similar to those in many living reptiles and that these served for the exuviation of the head and possibly to frighten enemies.

Scottish Cephalopods

FOR a number of years the Fishery Board for Scotland collected marine fauna over the Scottish area, using this term in a wide sense, and the Cephalopoda in this collection, together with those of the Royal Scottish Museum, Millport Marine Biological Station and the University of Glasgow, form the basis for an account of this group by A. C. Stephen (*Trans. Roy. Soc. Edin.*, 61, Pt. 1; 1944). In all, 47 species and one variety are dealt with, but some of these are not strictly Scottish although, occurring in adjacent waters, they might be found within the narrower limits at any time. None of them is a new species; but our knowledge of the areas of distribution of some of them has been considerably extended. There is evidence to show that an increase in the flow of the North Atlantic Drift has been responsible for the immigration of several forms in comparatively recent years. These species are mainly southern forms like *Ommatostrephes sagittatus* and *Stenoteuthis caroli*; on the other hand, *Rossia glaucopsis*, a northern form, appears to have become more rare.

Termites of New Zealand

J. M. KELSEY has given (*N.Z. J. Sci. and Tech.*, May 1944) an account of the termites known from New Zealand and their identification. It appears that there are only two species indigenous to the Dominion, namely, *Calotermes brouni* Frogg. and *Stolotermes ruficeps* Brauer. In addition to these, there are eight species of Australian termites that have been accidentally introduced at one time or another. Of the native species, *C. brouni* does extensive damage to wooden buildings, posts, poles and trees. Attempts are now being made to find an effective means for its control. The other species, namely, *S. ruficeps*, is invariably found in decaying timber and has not so far been found attacking buildings. Of the Australian species, three kinds belong to the family Rhinotermitidæ and are members of the genus *Coptotermes*. Four species are members of the Calotermidæ, and of these three belong to the genus *Calotermes* and one to *Porotermes*. The Termitidæ are represented by a single species of *Eutermes*. The paper gives detailed descriptions of the eight species referred to above, together with illustrations of the chief distinguishing characters that separate them.

Golgi Bodies

REALIZING that much of the extensive work that has been done on the Golgi elements is based upon empirical procedures because of the lack of knowledge of their chemical nature and composition, Dr. J. R. Baker (*Quart. J. Micro. Sci.*, **85**, Pt. 1; 1944) has tackled the problem of their structure from a new point of view. For the purpose of this study the author took the spermatocytes and early spermatids of the snail *Helix aspersa*, intestinal cells from the newt *Triturus vulgaris* and cells from the anterior mesenteric ganglion of the rabbit *Oryctolagus cuniculus*, which he considered gave him a wide enough range of animals and tissues to allow generalizing. Structurally, it was found that the Golgi element consists of four parts, the 'neutral red vacuoles', a dense lipoid containing substance in various shapes, a diffuse lipoid-containing substance filling in the interstices and a Golgi product which arises in the vacuole by synthesis by the element. The first part of the paper consists of a description of the structures found, checked up where possible against the structures visible in the living cell. The second part is an account of the chemical nature of the structures and their reactions to various techniques.

Sex Determination in *Habrobracon*

P. W. WHITING (*J. Hered.*, **34**, 355; 1943) has summarized the recent data on sex determination in the parasitic wasp *Habrobracon*. Formerly it was believed that the female was XY and the male haploid X or Y, or diploid XX or YY in respect to the sex determiners. It is now shown that sex determination is controlled by a series of multiple allelomorphs in such a way that the heterozygotes are female, and the haploids and homozygotes are male. Some rather novel results are obtained consequently in sex linkage and in the nature and occurrence of sex mosaics. Haploid mosaic males appear at a frequency between 1 in 500 and 1 in 5,000 in the progeny of heterozygous females. They arise from binucleate eggs. In a few cases trinucleate eggs must have been involved. Also females have arisen without fertilization as a result of doubling of the chromosome number in the oogonia. Dispermy is relatively frequent, but the expected androgenesis is rare. The sex reactions of the insect were known to be associated with the head, but it is now known that an insect with female eyes and male antennæ reacts as a female, thus limiting considerably the tissues which are associated with sex reactions.

Plant Growth Substances

THE relation between molecular configuration and activity of plant growth substances or auxins has yet to be elucidated; but V. T. Stoutemeyer (*Proc. Amer. Soc. Hort. Sci.*, 42, 365; 1943) reports that the addition of methyl, hydrogen and isoprene groups at various positions on naphthalene acetic acid does not reduce its root-forming properties. The addition of the isoprene group in some cases actually increased activity, while tetrahydronaphthalene acetic acid usually caused the production of a greater weight of roots per cutting (without increasing the number of cuttings rooted) than the unreduced acid. The same worker later reports that while naphthalene butyric acid is as effective as (and less toxic than) the corresponding acetic acid, and the isoprene ester of the naphthalene butyric acid is still more effective, α-naphthalene α-propionic and α-naphthalene β-propionic acid were both less effective than α-naphthalene acetic acid.

Effect of Methyl Cellulose on Water-loss in Plants

IN a short note, I. M. Feller and V. R. Gardner (*Proc. Amer. Soc. Hort. Sci.*, 43, 183; 1943) describe an experiment, the results of which may have far-reaching consequences. They show that the addition of a 1 per cent or 2 per cent aqueous suspension of methyl cellulose to bare soil or to soil in which plants were growing in a greenhouse reduced water loss from both soil and plant by as much as 50 per cent without exerting any observable harmful effects on the plants. Initial treatment remained effective for three months. If further experiments show that repeated treatments have no harmful effects on the soil and on plant growth, these experiments may prove to be of prime importance in at least a limited field of horticulture.

Polythene as a High-Frequency Dielectric

Prof. Willis Jackson and Mr. J. S. A. Forsyth recently read a paper on this subject in London before the Institution of Electrical Engineers. The paper is mainly concerned with the power factor of polythene which, being normally of the order of 0·00015–0·0003, renders the material very suitable as a high-frequency dielectric. Oxidation may occur, however, during the processing of the material in the manufacture of cables and mouldings; this increases the power factor and leads also to difficulties in extrusion. These effects may be virtually eliminated by the use of small amounts of antioxidants. The measurable power factor of pure polythene is scarcely concordant with the supposedly non-polar nature of the substance, and a number of possible explanations of the small basic power factor have been investigated. Measurements of power factor over wide frequency and temperature ranges show that its variation for pure polythene is extremely sluggish, but that oxidation causes the appearance of marked peaks; these observations are examined in the light of present theories of dipole loss. A brief account is given of the structure of polythene, and of its main physical and mechanical properties.

Observations of Eros at the Cape Observatory

A PAPER on observations of Eros during 1938 and 1942, communicated by H.M. Astronomer at the Cape (*Mon. Not. Roy. Astro. Soc.*, **104**, 3; 1944), includes a short description of the instruments used and of the method of reduction of the plates, etc. In 1938 the observations were made with the astrographic telescope west of the pier. In 1942 the first two or three exposures were generally made with the telescope west of the pier before Eros reached the meridian, then observations were made with the Victoria telescope near the meridian. Finally, the astrographic telescope was reversed and several exposures were made with the telescope east of the pier. The same plate was used for the two sets of exposures with the astrographic telescope and hence the mean of the two sets should eliminate any displacement due to tilt of the plate. The plates during 1938 were taken by Dr. R. H. Stoy, and in 1942 they were generally taken by Dr. J. Jackson. Tables with the results of the observations in the two years are given; but for 1938 the observed positions only are given, corrected for parallax and referred to the equinox of 1938·0. For 1942 an ephemeris by Stracke was available, and for comparison with this ephemeris it is only necessary to subtract the light-time from the time of observation, corrections for parallax and aberration having been applied to the positions given.

EPIDEMIOLOGY OF BARTONELLOSIS

IF any biologist requires a problem which will exercise to the full his patience and experimental skill, he could get it from the monograph "Infectious Anæmias due to Bartonella and Related Red Cell Parasites", by David Weinman (*Trans. Amer. Phil. Soc.*, Philadelphia, New Series, 33, Part 3, 243–350; 1944). Weinman was parasitologist to the Harvard Expedition to Peru in 1937, which finally established the fact that *Bartonella bacilliformis* is the cause of both Oroya fever and Verruga peruviana (Verruca peruviana, Verruga peruana), both of which are sometimes called Carrión's disease. Carrión, one of the pioneers of the study of these South American diseases, died of Oroya fever after inoculating himself with verruga material.

As Prof. Tyzzer says in his preface to this monograph, the symptoms of these two diseases are so different that it is not surprising that they were, until comparatively recently, considered to be due to different organisms. The main symptoms of Oroya fever are fever, marked pain in the head, joints and bones and a rapidly developing anæmia. If the patient does not die in a few weeks, a verrucous stage may follow. The mortality is 40 per cent or higher. Verruga peruviana is a milder infectious disease in which superficial and deep nodules appear. The superficial ones resemble warts and are about the size and colour of cranberries when they are mature; the subcutaneous ones are larger, less numerous and often erode the skin surface. These eruptions last from one to twelve months and then disappear. Mortality is low. Latent infections with *Bartonella bacilliformis* may occur without symptoms. It is now known that both diseases are due to the single species of *Bartonella*—*Bartonella bacilliformis*—which was formerly classed among the Protozoa, but is now classified by Tyzzer, Weinman and others as a flagellated bacillus.

The two diseases caused by this organism are both confined, at present, to a restricted area of South America, namely, to a narrow strip of the Andes in Peru to foci in the south-west of Ecuador and to the neighbourhood of the city of Pasto in Colombia. Central American foci in Honduras and Guatemala have been suspected, but have not been proved. Weinman points out, however, that human bartonellosis appears to be spreading in its epidemic form. In animals the related genera *Hæmobartonella* and *Eperythrozoon*, which have been, for reasons discussed by Weinman in this monograph, removed from the genus *Bartonella*, are widely distributed and may be present in laboratory animals used for studies of the blood or reticulo-endothelial system or for nutritional and other problems; they may profoundly affect the results of these studies. The comparative study of animal bartonellosis may, Weinman thinks, illuminate the etiology, pathogenesis and treatment of blood diseases. This study has already revealed that the spleen has an important immunological function in animals infected with *Bartonella*. It maintains an equilibrium between certain of these parasites and their hosts, which is so perfect that infection may never be apparent unless splenectomy is performed; and the study of this function of the spleen may give us new information about the relation of the spleen to immunity. We are here reminded of the work of J. E. Larsh, jun. (*Amer. J. Hyg.*, 39, 133; 1944; and *Trop. Dis. Bull.*, 41, 765; 1944) on the increased susceptibility of mice not infected with Bartonella to infestations with the cestode *Hymenolepis nana* var. *fraterna*, when the whole spleen (that is, a large part of the reticulo-endothelial system) is removed.

Historically the cutaneous form of human bartonellosis, Verruga peruviana (Verruga peruana), was known to the pre-Inca inhabitants of Peru. Among the illustrations of operations and diseases found on ancient pottery ('huacos') "pertaining to the Chimu civilization", Verruga peruviana has been identified. When the Spaniards arrived, they found that Verruga peruviana was already distinguished in the Keshua language from the common wart and other diseases. and the very first group of conquering Spaniards suffered from it. Less appears to be known about the history of the anæmic form of human bartonellosis (Oroya fever). A serious epidemic of it in 1870 in workers building a railway from Lima to Oroya caused 7,000 deaths, and this and later epidemics led to the popular saying that "every crosstie in the railroad represented a human life". The nature of Oroya fever was not clearly known until Carrión. who was dissatisfied with the existing knowledge of Verruga peruviana, decided to inoculate himself with verruga material. He developed Oroya fever and died of it on October 5, 1885. It was not until 1905 that Barton described bodies in the blood which were. he claimed, living organisms and the cause of Oroya fever. His claims were not accepted until the 1913 Harvard Expedition to Peru confirmed Barton's findings and gave the name *Bartonella bacilliformis* to the bodies which he had described. This Expedition made great contributions to our knowledge of the disease. But its etiology remained obscure until Noguchi and Battistini cultivated *B. bacilliformis*. The 1937 Harvard Expedition to Peru finally established the fact that *B. bacilliformis* causes both Oroya fever and Verruga peruviana.

B. bacilliformis is extremely polymorphous, and its taxonomy, microscopical appearance, cultivation and behaviour in experimental animals are fully described by Weinman. The symptoms of the various forms of the two diseases which it causes are also described in detail. The section on epidemiology and transmission by sandflies is valuable. *Phlebotomus verrucarum* seems to be the most important vector of the three species of *Phlebotomus* occurring in those areas of Peru in which bartonellosis is endemic (*P. verrucarum*, *P. noguchii*, *P. peruensis*). The four other Peruvian species of *Phlebotomus* have not yet been incriminated; and no other blood-sucking arthropod has been shown to be naturally infected with *Bartonella*. Infection by contact does not occur in ordinary circumstances. The disease has, however, been reported as a new one in Colombia since 1935, and none of the Peruvian sandflies has yet been collected in Colombia. This suggests that *B. bacilliformis* was introduced into Colombia and then became established in the Colombian sandflies, rather than that Peruvian infected sandflies became acclimatized in Colombia (as, for example, African *Anopheles gambiæ* became established in Brazil in 1939 and caused there one of the most devastating epidemics of malaria known to history (see *Nature*, 153, 765; May 20, 1944)). If this is so, the question arises whether other species of *Phlebotomus* could become vectors of *B. bacilliformis*. This question has not been studied experimentally. It is important, because sandflies which bite man are widely distributed throughout the world in tropical and temperate countries (cf. the part they play in transmitting to

man the cause of human cutaneous leishmaniasis (*Leishmania tropica*) in the Gerbils and Sousliks of the deserts of middle Asia, described in a review of Russian work on this question by C. A. Hoare (*Trop. Dis. Bull.*, 41, 331; 1944)). Modern rapid methods of transport could either carry the sandflies which transmit *Bartonella* or infected human beings to an area inhabited by uninfected sandflies.

Two alleged cases of congenital transmission of *Bartonella* in man are reported by Weinman, and the factors affecting susceptibility and resistance to the infection are discussed. Man is the only important known source of *B. bacilliformis*, and *Phlebotomus* the only other animal known to be naturally infected. There is, however, some evidence that dogs may be naturally infected sometimes. The suggestion that domestic animals, lizards, rats and some plants may be reservoirs of the infection has not been confirmed. Weinman discusses at length the immunology, treatment and control of the infection, but these complex questions cannot be discussed here. Treatment of Oroya fever is the most important, because of its high mortality, but the study of it is handicapped by our inability to produce the syndrome at will in experimental animals.

In Chapter 2 Weinman discusses the genus *Hæmobartonella*, created by Tyzzer and Weinman in 1939, to include *Bartonella*-like organisms which do not multiply outside the blood and do not produce skin eruptions, whereas human *B. bacilliformis* develops in fixed tissue cells and causes skin eruptions. *H. muris*, the type species, is a widely distributed parasite of the albino rat, in which it exists as a latent infection and causes anæmia. It is transmitted by rat lice and fleas. It is infectious for albino mice, the rabbit and some other rodents. It can be eradicated by neoarsphenamine and other organic arsenicals. Weinman describes fully the other species, of which twenty-one have been named. Those most clearly established are in albino rats and mice and some other rodents, in voles, guinea pigs, oxen, buffalo and dogs. Other forms of *Hæmobartonella* not of specific rank have been found in the wild rat, dormouse, opossum, hamster, deermouse and squirrel. Organisms having some resemblance to *Hæmobartonella* have been recorded from the bat, monkey, ant-eater, rat and dormouse and from the tortoise, frog, lizard, gecko, lamprey, tench and pike.

Chapter 3 deals with *Eperythrozoon*. Species of this genus are blood parasites with some resemblance to *Bartonella* and *Hæmobartonella*, and they cause anæmia in various vertebrates. The infection, which at first causes symptoms, becomes latent, and removal of the spleen causes relapses. These organisms have not yet been cultivated *in vitro*, but animals can be infected by inoculation of infected blood. Their transmission by arthropods is known and they respond to therapy with organic arsenicals, so that they are regarded as being living organisms. They occur in white mice (*E. coccoides*, transmitted by the louse, *Polyplax serrata*, and possibly by other means); in dwarf mice and voles (*E. dispar*); in sheep (*E. ovis*, the method of transmission is not known) and in cattle (*E. wenyoni*, the method of transmission is not known). Other so-called species require confirmation. The single case in which infection of man (a child) with *Eperythrozoon* was suspected is discussed by Weinman.

Chapter 4 discusses the public health aspects of bartonellosis. Its importance is shown by the fact that although the epidemic of 1870 in Peru involved a very small region, some 7,000 people died; and in Colombia more recently 4,000 deaths have been attributed to bartonellosis in one year (1938). The disease is, so far as we know, restricted to Peru, Colombia and Ecuador, and is irregularly distributed in a long, narrow area of the Andes, 1,000 miles long by about 100 miles wide, in which it occurs at moderate altitudes, near water and most often in narrow valleys; but it is probable that its distribution is incompletely known.

Man is both the victim and reservoir of *Bartonella bacilliformis* and no other animal naturally infected with this species is known, except the sandfly vector. Weinman discusses fully the epidemiological evidence for this. Further knowledge of the insect vector is required, because most of our knowledge about it has been worked out in Peru only. The nocturnal biting activity of the sandfly explains why the disease is chiefly contracted at night, and this biological fact has been used for control. Workmen repairing a railway bridge over the Rimac River were, for example, removed by train from the bridge in time to be outside the endemic zone before nightfall. *Phlebotomus*-proof buildings would be equally effective, and when Shannon lived for months in one of these in an endemic area, he did not become infected; but the expense of providing them for everyone would be great. Repellents applied to the body and insecticides are said to help protection. Other measures aim at reduction of the numbers of the sandflies by destruction of the day-time hiding places of the adults in dark places; but lack of knowledge of the biology of the immature stages handicaps this kind of control. The adults are not vigorous fliers and probably do not get very far from the places where they emerge. The fact that endemic foci of the disease are bounded by upper and lower limits of altitude, which are often quite sharply defined, requires further explanation.

G. LAPAGE.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND

THE eighteenth annual report of the Department of Scientific and Industrial Research, New Zealand, covering the year 1943–44, includes the Minister's statement, the Secretary's report, reports of the research committees of the Council, and on research work at the Canterbury and Massey Agricultural Colleges, as well as on the Dominion Laboratory, Observatory, Physical Laboratory, Magnetic Observatory, Geological Survey and Meteorological Branch.

Under the Building Research Committee, investigations have been continued by the Entomology Division of the Plant Research Bureau into the biology of the two native termites, and in co-operation with the Plant Diseases Division investigations were undertaken into the biology of *Anodium punctatum*, including the factors controlling oviposition and the influence of seasoning of both kiln- and air-dried sapwood against attack, with the view of securing data on the best method of treating various timbers as a protection against borer attack. The State Advances Corporation has continued its work on field investigations of timber-infesting insects and fungi, and field application of termite control and on

wood preservatives. A special committee was set up to deal with the problem of mould growth on the linings of houses; the report of the Plant Diseases Division shows that mould growth can be controlled by applying a 2 per cent solution of the sodium salt of pentachlorophenol to the materials used in finishing the wall surfaces. The Auckland Building Research Panel has investigated the behaviour under stress of a floor consisting of pre-cast reinforced concrete joists and slabs.

The Dairy Research Institute has again limited its research to projects concerned with the New Zealand war effort, but has continued to give advice and assistance with the commercial manufacture of dry butter-fat by the method developed at the Institute. Work on land cress taint in cream and butter has clearly indicated that the benzyl *iso*thiocyanate present in land cress is not the cause of the peculiar taint in the butter from cows consuming it, as garden cress contains the same glycoside. Principles laid down in the previous year for the protection of starter culture from infection with bacteriophage have proved sound, and many isolated starter rooms have been built during the year at commercial cheese factories. Continued experience has shown that single-strain starter cultures can be maintained free from infection over long periods where isolation together with aseptic handling is practised. A tentative start has been made on an investigation into the possible use of phage as a cure for mastitis in dairy cows. Some progress has been made in the field towards a cure for 'mechanical' openness in cheese. Hormone studies have covered milk secretion in dairy cattle and parturition in pigs.

Under the Food Preservation and Transport Advisory Committee, development work has continued on dehydrated meat, including the increase of the fat content to 40 per cent by addition of edible rendered tallow, and the installation of plant for the re-addition of the concentrated cooking juices to improve flavour and compatibility, and for packaging the dried meat under compression in accordance with specifications of the United Kingdom Ministry of Food. Commercial manufacture of dehydrated vegetables began at the end of March 1943, in a tunnel dehydrator of the Eidt type designed by the Chemical Engineering Section of the Dominion Laboratory; the plant has given performance and quality fully up to expectation. Dehydration of apples on behalf of the Internal Marketing Division has now reached the production stage. Fruit cold-storage research has included the refrigerated gas storage of apples, superficial scald on Granny Smith apples, the effect of fertilizers at the root on cold-storage quality and the control of wilt in cold-stored pears and apples. Under the Fruit Research Advisory Committee, long-term manurial investigations and root-stock trials on apples have continued and other work has covered stone fruit and citrus. Research at the Cawthron Institute has covered the magnesium deficiency of apples, distribution of magnesium and potassium in leader growth and apple-juice concentrates.

In the Industrial Psychology Division established towards the end of 1942, investigations have been in progress on absenteeism in forty-six factories in the four main centres of the Dominion, on the ventilation and heating of factory buildings, and on the reduction of fatigue and monotony, especially the effect of factory seating. The Division has also been responsible for the issue of a quarterly bulletin, lectures and addresses, service work for manufacturing concerns, co-operation with the Government Vocational Guidance Centres and work for the Armed Services. Under the Leather and Shoe Research Advisory Committee, the Leather Research Association has continued its work on the formulation of standards for sole leather, the flexibility of sole leather and a field trial to determine whether any relation could be established between wet rigidity and actual wearing value. The Shoe Research Association has investigated the effect of the method of construction on the flexibility of the shoe with the object of linking the work up with that on the flexibility of sole leather. Pelt research is yielding concrete results due to the institution of chemical controls in the process and the checking of the curing process in the finished pickled pelts.

Investigations at the Cawthron Institute on the mineral content of pasture have covered the effectiveness of application of cobalt sulphate in field trials. Under the Mineral Resources Committee, the prospecting and boring of the Clarendon phosphate deposits has been directed, and the results of the quantitative surveys of the Chatham Island peat wax deposits, with chemical work at the Dominion Laboratory and the Imperial Institute, have been published.

The New Zealand Wool Manufacturers' Research Association has continued its work on improvements to the wet chlorination process of rendering woollen fabrics resistant to shrinkage. The Plant Chemistry Laboratory has continued its research on the suitability of different varieties of vegetables for dehydration, and satisfactory results have now been obtained in dehydrating peas and beans. Under the Plant Research Bureau, work on linen flax has included the production of pure seed and weed control, and the Botany Division has also continued weed investigations, work on fibre plants and on medicinal plants. Investigations on the Russian dandelion indicate that a solution of the difficulties involved in direct sowing is crucial to development. The Entomology Division has continued its survey of the diamond-back moth, cocksfoot stem-borer, and cheese-mites, and has found that dichloroethyl ether is highly toxic to the common cheese-mite, even at very low concentrations. The Grasslands Division has maintained its plant-breeding programme with perennial rye grass, Italian rye grass, short-rotation rye grass, Western Wolths rye grass, cocksfoot, timothy, white clover and red clover, and there has been no slackening of the work on aerodrome grassing and turf. Work on green-keeping research has continued, and plant disease investigations under the Plant Diseases Division have covered linen flax diseases, legume diseases, vegetable diseases and diseases of medicinal plants. The Soil Survey Division has devoted attention to soil fertility problems and produced maps showing where this is being reduced through erosion. Tobacco research has included fertilizer experiments, investigations on mosaic and other tobacco diseases, seed production and plant breeding, the chemistry of curing and recovery of nicotine from waste tobacco. Research work at the Canterbury Agricultural College has included sheep-dipping experiments, investigations on insect pests of wheat crops, and wool survey by the Wool Metrological Laboratory; while at the Massey Agricultural College sheep-nutrition experiments, drainage research work and work on sheep-breeding methods and pig research have been in

progress. Root development work, which has now been suspended, is reviewed in the report.

In addition to testing work the Dominion Laboratory has been concerned with research work, the Chemical Engineering Section being largely occupied with work connected with the dehydration of vegetables and apples, while the Physical Chemistry Section has been concerned mainly with spectrographic analysis. The Coal Survey Laboratory has continued its physical and chemical survey of the coal resources of the Dominion. Many investigations on paints and protective coatings have been carried out during the year both for defence and civilian purposes. Rubber problems investigated during the year included particle-size and other determinations of rubber fillers, preparation of rubber solutions, investigation of rubber tyre preservatives, rubberware for milking machines, and an examination of the possibility of manufacturing synthetic rubber in New Zealand. At the Dominion Physical Laboratory, the physical testing and electrical laboratory was concerned with the yield and quality of linen flax fibre, dimensional changes of trace line paper for map reproduction, mould on inner wall surfaces in New Zealand houses and the application of radioactive luminous paint for equipment.

At the Magnetic Observatory, Christchurch, the programme of work in terrestrial magnetism, seismology, cosmic radiation, atmospheric electricity and meteorology was generally maintained during the year.

BATS

By OLIVER G. PIKE

THERE are very few naturalists who can with certainty distinguish British bats in flight. It even comes as a surprise to many to learn that there are twelve species in Great Britain. The chief reason British bats have been so neglected is that they appear, except at rare intervals, at dusk and before dawn, and are therefore very difficult to observe. Apart from this, they live, as a rule, in rather inaccessible places, and most of their daylight haunts are dark.

When watching a bat on the wing, we are looking upon the most perfect example of flight. I do not know any bird that can equal their powers of manœuvring; a bat going full speed (and it can travel fast) will suddenly stop, do a quick right or left turn, rise and dive, turn completely over, and perform other stunts that are bewildering to watch.

To many, bats are mammals without a voice. This is because the high-pitched cry, which is very frequently uttered while flying, is beyond the powers of hearing of about three out of every four people, while the low, loud noises, such as the beating of a large gong, make no impression on them.

Bats are flying mammals; through the millions of years of evolution their arms have changed into wings. If we examine the wing of a bat, we see how the bones are really exaggerated fingers, with a thin flexible skin stretched over them, while on the bone that corresponds with our thumb there is a hook, which the animal uses to attach itself to some support while resting.

All bats have one young only during the year, which is born in mid-summer; they are helpless at birth, and for several days are carried around by the mothers while they search for their own food. When too heavy to carry, they remain in their haunt until about seven weeks old; then they are able to fly and search for food on their own account.

THE LONG-EARED BAT.

It is doubtful if the bat ever uses its eyes while searching for insect food; experiments have shown that bats which have been blindfolded and liberated in a room in which several strings were hung from the ceiling were able to avoid them with the greatest ease. To make up for the lack of sight, they seem to be provided with a sense of which we know little, and to which it is difficult to give a name, but which appears to be connected with the 'earlet' of the ten species in the family Vespertilionidæ, and the very remarkable facial development known as the 'horseshoe' on the two species in the family Rhinolophidæ. These organs, combined with their keen sense of hearing, assist them to dodge all obstructions, and to find insect food while flying in the dark.

Bats are the only surviving back-boned animals, with the exception of the great class of birds, that are able to fly, but unlike the birds, they are rather helpless except while in the air.

There is a vast field open for the enthusiastic naturalist who cares to undertake the serious, but difficult, study of these nocturnal mammals.

Some excellent work has been done in this respect by Mr. Brian Vesey-Fitzgerald, editor of the *Field*. In the *Proceedings of the Hampshire Field Club*, **16**, Part 1, pp. 64–71, he gives a detailed and valuable description of each of the twelve species found in the county, together with their distribution, founded upon his personal observations.

If naturalists in other counties would follow in his steps, we should gather a deal of valuable information about these much-neglected mammals.

KED-FLIES

THE ked-flies are blood-sucking Diptera, ecto-parasitic on certain of the ruminant artiodactyls. Since species occur on domesticated sheep and goats, they are of veterinary significance though not yet incriminated of acting as vectors of actual disease; occasionally they bite man. Information about these flies has been somewhat scattered, and a recent monograph[1] of the group by Prof. J. Bequaert of Harvard is, accordingly, very welcome. Prof. Bequaert has already published many shorter papers on the Hippoboscidæ, of which the Melophaginæ or ked-flies are a sub-family; his monograph of the ked-flies is thus the outcome of prolonged study.

The ked-flies show many interesting adaptations to their ectoparasitic mode of life. They are tough, leathery, compact and somewhat flattened creatures. All are viviparous, producing larvæ that are fully developed and ready to pupate one at a time. The female reproductive organs are much modified, in a manner very similar to that of the tsetse flies (*Glossina*), for the retention of the larva and its nourishment.

The Melophaginæ comprise four genera, *Neolipoptena*, *Lipoptena*, *Echestypus* and *Melophagus*. Species of the first three genera occur on a variety of goats, antelopes, deer, etc. They are all winged on emergence from the puparium, but the wings are cast when the flies have reached a suitable host. The mature larvæ, on being extruded by the females, apparently fall from the hairy pelts of their hosts and pupate on the ground. The only British representative of this group is *Lipoptena cervi* L., the ked of the red deer[2].

The genus *Melophagus* contains only two species. One of these, *Melophagus ovinus* Linnaeus, the sheep ked, is common in the British Isles[2]. This species is now widespread, having been transported on its principal host, the domestic sheep. It does not, however, survive in all climates. Other hosts from which it has been recorded are the Marco Polo sheep and the Alaskan mountain sheep; but Bequaert[1] states that the ectoparasites of these two sheep have never been properly investigated and that the records are dubious. The other species, *Melophagus rupicaprinus* Rondani occurs on the chamois. The adults of *Melophagus* are completely wingless. In the case of the sheep ked the larvæ do not normally fall to the ground but pupate in the fleece of the host and stick there. Powers of flight are thus not required by the adult when it emerges from the puparium. Nothing is known of the life-history of the chamois ked but, as Bequaert points out, the chamois has an undercoat of short wool beneath the visible pelt of longer hairs.

Bequaert discusses the probable evolution of the Melophaginæ. He considers that the family Hippoboscidæ appeared in the Cretaceous and that they were originally all ectoparasites of birds. He thinks that the passage from birds to the artiodactyls took place when the latter began to arise in the Lower Eocene. There are no fossil Hippoboscidæ but, taking the family as a whole, 65 per cent of the recognized genera and 88 per cent of the recognized species of recent Hippoboscidæ are parasitic on birds. Furthermore, no recent Hippoboscidæ have small mammals as their hosts; and at the time when the Hippoboscidæ appear to have arisen (late Mesozoic) there was a variety of birds but only small mammals. The plumage of any bird offers good protection to larger ectoparasites like the Hippoboscidæ, while smaller mammals can usually kill larger ectoparasites in the pelt.

It would seem that the fate of recent Melophaginæ is intimately linked up with the fate of the artiodactyls, since they have left the birds and have become highly specialized for an ectoparasitic existence on these mammals. This order of mammals has a great past in the Oligocene and the Pliocene, but it is now on the wane. Bequaert suggests that the Melophaginæ may disappear within the next century should the present decline of their wild hosts continue; efficient insecticides may cause the species on the domestic sheep to suffer a like eclipse.

A century hence, naturalists may be consulting Prof. Bequaert's monograph for information about an extinct sub-family of the Diptera.

JOHN SMART.

[1] Bequaert, J., "A Monograph of the Melophaginæ, or Ked-Flies, of Sheep, Goats, Deer and Antelopes (Diptera, Hippoboscidæ)". *Entomologica Americana*, 22, 1 (1942).

[2] Edwards, F. W., Oldroyd, H., and Smart, J., "British Blood Sucking Flies", 118 (1939).

THE INDIAN FAUNA DURING 1942–43

AN interesting tabular statement is given in the *Indian Forester* (70, No. 4, April 1944. Civil and Military Gazette Ltd., Lahore) of the animals shot in some of the Indian Provinces and States during 1942–43. Of British India, only Madras appears to have sent in no figures. The Indian States are confined to Jammu and Kashmir.

The protection of some of the species which two score years ago were in grave danger of becoming extinct has to some extent been safeguarded through the advent of the game sanctuary. Rhinoceros was one of the animals threatened. During 1942–43, only two rhinoceroses were killed in the whole of India, in the province of Assam. Of gaur or bison, 25 only (Madras sent in no returns, unfortunately) were shot, the greater number in the Bombay Presidency (9) and the Central Provinces (8), while none of its close relative the goyal or mithan was killed; nor any banting or tsine. Of wild buffalo, another animal the numbers of which were seriously decreasing, only four were shot in Assam. Wild elephants, killed in British India at least, do not really afford much light on the numbers extant in the different provinces, for the individual public are only allowed to shoot or trap any animal specially proscribed as dangerous or, in the second case, with a special permit from Government. Thirty-two are shown to have been shot in the several provinces; there is a footnote to the statement, however, which says that a few sambar, barking deer and wild elephants—a curious assemblage—were killed by military units in Chittagong District, Bengal.

Turning to the Carnivora, a total of 219 tiger and tigresses were shot, the greater number in the Central Provinces and Berar (65), and the United Provinces (91); of leopard or panther 173 were shot, the United Provinces again heading the list of kills with 54, the Central Provinces 44, and Bombay Presidency 32; the hunting leopard or cheetah is confined, so far as animals shot are concerned, to Coorg (31), and Jammu and Kashmir (15), a curious record in distribution of the animal possibly due to incorrect diagnosis. The records of wild dog (28 shot only) are

disquieting when the ravages among the deer tribe it is capable of committing are remembered; and of the wolf, 1 shot in Sind and 34 in Jammu and Kashmir are zoologically of interest.

The bears, for several reasons connected with their varied and wide distribution, are, from the 1942–43 record, curious. Of the brown bear, only three were shot; Himalayan black bear 64, of which 51 were in Jammu and Kashmir. Malayan bear, for perhaps obvious reasons so far as British records go, nil; sloth bear 28, of which 16 were in Jammu and Kashmir and 8 in the Central Provinces. Of the deer tribe, 255 sambar were shot (C.P. 84; U.P. 75; and Bengal 26), and cheetal or spotted deer 291 (U.P. 177, C.P. 78, and Bengal 24).

Turning now to the Himalayan fauna, only 4 urial or sharpu were shot, 1 bharal or blue sheep, 7 ibex (Kashmir) and 2 markhor; 5 tahr, no serow, which is curious, and only 10 goral. Of the common little black buck of the plains, the return shows only three shot.

This return for 1942–43 is of some interest and value since it appears to indicate that the large increase in the fighting forces in India has not synchronized with a far heavier mortality in wild animals, as might have been anticipated.

FORTHCOMING EVENTS

Saturday, January 27

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at Caxton Hall, Westminster, London, S.W.1), at 2.30 p.m.—Mr. H. K. Bourne: "Electric Discharge Lamps for Photography".

Monday, January 29

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. W. H. Ward: "The Stability of Natural Slopes".

Tuesday, January 30

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Imperial Institute, Exhibition Road, South Kensington, London, S.W.7), at 1.30 p.m.—Mrs. Bertild Bekker: "Ma-Maroh" (Devil-Feast).

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2 p.m.—Mr. T. A. Wedderspoon: "Soil Cultivation" (supporting Intensive Cultivation); Dr. E. W. Russell: "Soil Cultivation" (supporting the Minimum of Cultivation).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. T. Wallace: "The Diagnosis of Mineral Deficiencies in Crop Plants", (1) "Visible Symptoms produced by Mineral Deficiencies".

SHEFFIELD METALLURGICAL ASSOCIATION (at the Royal Victoria Station Hotel, Sheffield), at 6.30 p.m.—Sir Alexander Dunbar: "The Future of the Steel Industry".

Wednesday, January 31

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. Pierce Clingan: "National Building Regulations".

SOCIETY of CHEMICAL INDUSTRY (MICROBIOLOGICAL PANEL OF THE FOOD GROUP) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.15 p.m.—Dr. T. F. West and Mr. G. A. Campbell: "The Story of D.D.T. and its Role in Anti-Pest Measures".

INSTITUTE OF WELDING (at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1), at 6 p.m.—Discussion on "Welding in Higher Technical Education" (to be opened by Prof. H. Wright Baker and Mr. H. Martin).

Thursday, February 1

INSTITUTE of FUEL (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—Mr. P. M. K. Embling: "The Gasification of Bituminous Coal in Producers".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S.: "Locomotory Mechanisms in Vertebrate Animals", (1) "Swimming of Dolphins; Gliding and other Types of Movement in Snakes".

INSTITUTION OF ELECTRICAL ENGINEERS (joint meeting with the INDUSTRIAL RADIOLOGY GROUP OF THE INSTITUTE OF PHYSICS) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. V. E. Pullin: "A Survey of X-Rays in Engineering and Industry".

Friday, February 2

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Metal Crystals and Crystal Strength".

SOCIETY OF CHEMICAL INDUSTRY (joint meeting of the PLASTICS GROUP with the MANCHESTER SECTION OF THE S.C.I.) (at the Grand Hotel, Aytoun Street, Manchester), at 6 p.m.—Dr. W. J. S. Naunton: "The Influence of Auxiliary Chemicals on the Past and Future Development of Synthetic Rubber".

Saturday, February 3

BIOCHEMICAL SOCIETY (at the British Post-Graduate Medical School, Ducane Road, Shepherds Bush, London, W.12), at 11 a.m.

APPOINTMENTS VACANT

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

DEPUTY BOROUGH ELECTRICAL ENGINEER AND MANAGER, Corporation of Barking—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. D.1048.XA) (January 31).

DEPUTY BOROUGH ELECTRICAL ENGINEER, Borough of Royal Tunbridge Wells—The Ministry of Labour and National Service, Appointments Dept. A3(B), Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. D.1042.XA) (January 31).

ASSISTANT ENGINEER by the Government of the Tanganyika Territory—The Ministry of Labour and National Service, Appointments Department A3(B), Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. E.1149.A) (February 2).

MECHANICAL MAINTENANCE ENGINEER in the Swansea Electricity Department—The Borough Electrical Engineer and Manager, Guildhall, Swansea (February 3).

ASSISTANT IN THE DEPARTMENT OF ECONOMICS for the Farm Management Survey Scheme—The Acting Principal, South-Eastern Agricultural College, Wye, Ashford, Kent (February 3).

LECTURER (full-time) IN MATHEMATICS in the Science Department—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (February 3).

LECTURER (full-time) with special responsibility for ELECTRICAL ENGINEERING in the Bolton Municipal Technical College—The Director of Education, Education Offices, Bolton, Lancs. (February 5).

METALLURGIST for works in South Midlands on essential war work, and with post-war interests in mass production of refrigerators, domestic equipment, etc.—The Ministry of Labour and National Service, Appointments Department A3(B), Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.3386.XA) (February 6).

GENERAL MANAGER AND ENGINEER OF THE STOCKTON-ON-TEES ELECTRICITY DEPARTMENT—The Town Clerk, Barclays Bank Chambers, Stockton-on-Tees (endorsed 'Electricity General Manager and Engineer') (February 7).

QUALIFIED METALLURGIST for large Iron Foundry by old-established Engineers in East Midlands manufacturing specialized machinery—The Ministry of Labour and National Service, Appointments Dept. A3(B), Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.3127.XA) (February 8).

TECHNICAL LIBRARIAN (female) by small works located in S.E. London—The Ministry of Labour and National Service, Central Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. A.770.XA) (February 9).

SPEECH THERAPIST—The Director of Education, Education Offices, 15 John Street, Sunderland (February 12).

LECTURER IN ELECTRICAL ENGINEERING SUBJECTS, and a TEACHER OF GENERAL SCIENCE, in the Ipswich School of Technology—The Chief Education Officer, Education Department, 17 Tower Street, Ipswich (February 16).

UNIVERSITY READERSHIP IN LOGIC AND SCIENTIFIC METHOD, tenable at the London School of Economics and Political Science—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (February 26).

PSYCHOLOGIST to the Essex Education Committee—The Chief Education Officer, County Offices, Chelmsford (February 28).

UNIVERSITY CHAIR OF CIVIL AND MECHANICAL ENGINEERING, tenable at Queen Mary College—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (March 1).

ASSISTANT SECRETARY jointly to the Glass Delagacy of the University of Sheffield and to the Society of Glass Technology—The Registrar, The University, Sheffield.

GRADUATE TEACHER OF GENERAL SCIENCE in the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent.

ASSISTANT MASTER to teach MECHANICAL ENGINEERING SUBJECTS—The Principal, Technical College, Wolverton, Bucks.

LABORATORY ASSISTANT (skilled) FOR PHYSIOLOGY DEPARTMENT—The Vice-Dean, St. Bartholomew's Hospital Medical College, c/o Queen's College, Cambridge.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)]

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 5, No. 6 (July–December 1943); No. 7 (January–June 1944). Pp. ii+97–152. (London: Royal Meteorological Society, 1944.) 5s. [115