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FORESTRY AND AGRICULTURE

IN previous issues of *Nature* (Sept. 25, 1943, p. 337, and Dec. 2, 1944, p. 693), we have reviewed the proposals made by H.M. Forestry Commissioners and the Royal Forestry Societies of Scotland and England for the future administration and control of forestry in Great Britain. Matters were taken an important stage further on February 15, when Sir John Anderson made a statement in the House of Commons that for "securing more complete and more direct Ministerial and Parliamentary control, the better co-ordination of the development of agriculture and forestry, and the most efficient use of the woodlands which survive the War, and of further land available for afforestation", it was best to "enlarge the sphere of the Ministry of Agriculture and Fisheries and the Secretary of State for Scotland, so that these Ministers may become jointly responsible for forestry policy and for supervising the measures for its execution". This decision—reached, it is reported, after prolonged consideration of various possible alternatives—should occasion no great surprise, and should be admitted to come as near as it is possible to come to reconciling the divergent views expressed on the subject. Details are not yet available, but it was definitely stated that under this arrangement, "the Forestry Commission will be retained as a single continuing expert body responsible directly to Ministers for advice on forest policy and for carrying out operations including training, research and forest holding".

There has been general agreement among those interested that the existing position was no longer satisfactory, however well it may have been suited to the conditions prevailing when the Commission was set up in 1919. Critics have reiterated their view that there should be direct Ministerial and Parliamentary control in place of the peculiar position, only paralleled to some extent by such bodies as the Ecclesiastical Commission, of being included in no department of Government and controlled only in financial matters by the Treasury. They have also expressed dissatisfaction with the composition of the Commission and the method of appointment to it. It is always easier to point out what is believed to be wrong with an organization than to provide a certain remedy, and though the various proposals run on fairly similar lines, it cannot be said that there is unanimity as to what would at this stage constitute the best composition of a revised Forestry Commission and how appointments should be made to it. It will be noted that there is fairly general agreement, however, that in one form or another, a commission does provide the best machinery for carrying out the forestry work required to be done in Great Britain during the post-war period.

Taking first this question of Ministerial control, it will be remembered that the Commission's own proposal (Cmd. 6447, par. 55) was that if, despite its recommendations, Parliament should wish it to be placed under the control of a Minister, that Minister should be the Lord President of the Council, perhaps

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working through a committee for forestry including the Secretary of State for Scotland, the Minister of Agriculture and the chairman of the Commission. The Royal Scottish and Royal English Forestry Societies made the same recommendation, but they set out their reasons at some length (Report on Post-war Forestry, 1944, p. 23). To the layman, it would seem obvious that if it is advisable to include forestry in an existing Ministry, it should go with the closely related field of agriculture, and he would probably find it difficult to imagine why both the Commission and its critics should wish forestry to be included among the bodies under the control of the Lord President, which include the three important research bodies, the Medical Research Council, Agricultural Research Council and Department of Scientific and Industrial Research. What is it, then, that prompts the forester to look for some alternative to such linkage at the Ministerial level with agriculture? The answer lies primarily in his belief that there is a real risk that a Ministry of Agriculture might not accord to forestry that share of interest, staff and total available resources to which forestry considers itself entitled; that, in the terms of a much repeated quotation, agriculture might in fact treat forestry as its handmaid, taking moreover an out-of-date view of the proper relations between mistress and handmaid. If then the further question is put—What grounds has the forester for this mistrust?—reference might be made to the history of the relationship between the two forms of land use in certain parts of the British Empire, where forestry, when it was in competition with agriculture, appears to have had a difficult struggle to obtain a full hearing of its case and adequate recognition. Some of these points do indeed appear to support the argument; but clearly much depends on the setting, and it is easy—again ignoring the setting—to find illustrations working in the opposite sense; for example, the ultimately successful demand of the United States Forest Service early in its history to be included in the Department of Agriculture, and the strong opposition more recently to any proposal to break up this administrative arrangement. The situation seems to call for careful consideration and, if necessary, the provision of some such safeguard as expressly earmarking funds for forestry. In view of the known interest in forestry of the Ministers who are at present responsible for agriculture in Britain, foresters need have few fears; but both appointments are political and the incumbents subject to change.

There was, moreover, thought to be a constitutional consequence of placing forestry in the same hands as agriculture, which British foresters generally deemed highly undesirable, namely, a splitting up of the existing single organization for Great Britain as a whole into two parts, one for Scotland under the Secretary of State for Scotland, and the other for England and Wales under the Minister of Agriculture and Fisheries. H.M. Commissioners are emphatic on the point (Cmd. 6447, par. 533), and so are the two Forestry Societies, though they consider the difficulty could be got over (cf. their Report, p. 23). Unity is

considered necessary to "ensure the high standard and *esprit de corps* expected of the Forest Service, adequate services for research, education and information, and a strong front to carry out an agreed national policy". It will be noted that this need arises from the fact that in Britain, even after the considerable expansion contemplated, forestry will still remain as a relatively small item on the national programme. Subdivision would mean further loss of strength, and the two services would each, in several aspects of their work, be too small for efficiency with economy. Obviously there must be a large measure of decentralization, permitting matters which are of purely Scottish concern being dealt with in Scotland, but no significant change from the present position will be required to ensure this. There will be dissatisfaction in Wales if special provision is not included to ensure the fullest consideration of Welsh interests, particularly as Wales will certainly be called on to provide a large proportion of the land required for afforestation. The existing consultative committees have been found to be too exclusively consultative, too lacking in power to press their views, to be acceptable.

It will be noted with approval that the Government has taken into account the need of the better co-ordination of agriculture and forestry. This is in keeping with the times, for this need is becoming more and more apparent to thinking men in both professions, as well as to those responsible for general administration. The Forestry Commission has often been charged with disregarding it when acquiring land for State afforestation. It is of even greater importance in the case of privately owned woodlands, which must almost always be handled as an integral part of a mixed estate—woodland, arable and pasture, all having their appropriate balanced parts to play in the general rural economy.

The statement made in the House of Commons also indicates that although we shall continue to have a Forestry Commission appointed by the Crown, its composition will be fundamentally altered by dropping the practice which has grown up of appointing representatives of each of the three chief political parties—one of the Commissioners had to be a member of the House of Commons to act as spokesman.

Men of science will note the specific mention of research as remaining under the control of the Forestry Commission, and perhaps wonder why it is not proposed to bring it under the Agricultural Research Council, as this would seem to be a logical step if the Ministry of Agriculture is to become responsible for forestry. A further announcement will be looked for with interest, as there have been numerous charges of inadequate attention to research in the past; but it may be noted that it would be quite possible for the necessary work to be shared between the Agricultural Research Council and the Ministry. The Ministry of Agriculture already has its own research stations for special problems, particularly those of a highly technological nature, and there are strong reasons why the Forestry Commission should in any event continue research of this type on

a wider scale than hitherto. Research of a more fundamental nature, which it has been the practice to 'farm out' to universities and other institutions wherever the best facilities were considered to exist for handling the individual problems, could perhaps more appropriately be taken over by the Agricultural Research Council, suitably enlarged by inclusion of persons with expert knowledge of the scientific aspects of forestry. There is a vast field for research into primary forest soils, tree physiology, and forest ecology in the widest sense, that has hitherto been much neglected. A variety of reasons for this neglect has been adduced, including experimental difficulties, lack of realization of the need for research, and lack of appreciation of the practical importance of the work. The essential requirement now is to remedy this, whatever is decided to be the best administrative arrangement to that end.

The accomplishments of the Forestry Commission during the first twenty-five years of its existence are reviewed in an article by Prof. E. P. Stebbing appearing in this issue (p. 317). If not a few matters are found for criticism, the reasons are often to be traced to the conditions under which the work has had to be done. It is indisputable that a great deal of valuable work has been accomplished during this quarter of a century, the completion of which would in any event have been a very appropriate time to take stock of the position reached. The initial difficulties involved in launching forestry as a new State activity have been successfully met. The nation's requirements can now be re-assessed and plans laid for a further period on the long-term views essential to sound forestry. In particular, we should now leave behind us the over-emphasis that has been laid on the afforestation aspects, give more attention to tending and management, and to preparing for the utilization problems that will shortly be upon us as the large acreages of plantation come into production. But the most significant feature of development to be anticipated in the draft legislation we are promised shortly is the proposed extension of the State's direct interest in some two million acres of privately owned forest. The Commissioners will need much imagination, tact and skill if at the end of the second twenty-five years they are to record as much progress in this field as they can record for their afforestation work since 1919. We believe this to be possible, and we certainly wish them every success in their task.

THE ROYAL SOCIETY, 1660-1940

The Royal Society, 1660-1940

A History of its Administration under its Charters. By Sir Henry Lyons. Pp. x+354. (Cambridge: At the University Press, 1944.) 25s. net.

AFTER Sir Henry Lyons had finished his work on the fourth edition of the "Record of the Royal Society", he wrote in June 1940 to the present reviewer: "I have learned that what is badly needed is a new 'History', for, as you know, Weld's ends at 1830. . . . Greatly daring I started on this about 2½ years ago and have got my first rough draft of half

of it in shape already. Now that I have got most of my facts collected and checked I see my way more clearly. . . ."; and again, in November 1941, "The further I get with it the less satisfied I feel. . . . The subject tempts one to fling a wide net, but I have tried to keep to the story of how the Councils and the Fellows carried out their trust as laid down in the Charters, and with what degree of success. . . .". Notwithstanding the dislocations and discomforts of war-time aggravated by growing illness, he steadfastly completed that task, and lived to see his text in print but not to see it published. In the book, he says that he regards it as the introduction to a second volume which must be left for another hand to write a century or two hence: a remark which well illustrates the sense of continuity that permeates his work; and indeed, every fellow of the Royal Society should, with like diffidence, be a 'student of perpetuity'.

After a note by Sir Henry Dale, president of the Royal Society, and the author's introduction, the seven chapters of the book flow in chronological order from the sixteen-forties to 1940 (with repetitions wherever the author has not let system stand in the way of narrative needs), so as to bring out well-marked successive changes in the Society's life. Appendixes give a full translation of the second Charter (1663) into English, and statistical data; and there is a full index of names and subjects.

Throughout the book the author repeatedly insists—and produces evidence for it—that a scientific society can be run only by scientific men. The Charter of 1663 had expressed the lofty vision and purpose of the scientific founders and their wise lay supporters; but their momentum waned with the century; and during the seventeen-hundreds and later, the growing proportion of non-scientific fellows exercised, as the author shows, "a restraining influence on the Society's activity and hindered its steady growth as a scientific institution; after 1820 the control of the Society passed into the hands of men of science with the result that it quickly became what its founders had originally intended it to be, an institution devoted wholly to the advancement of scientific knowledge".

As would be expected from Sir Henry Lyons—a fellow of the Society for thirty-eight years and its treasurer for ten—the evidence which he presents is never guesswork; he always goes to original sources; much is from documents not hitherto used for publication; and, wherever he can, he adds quantitative data. Thus, not only is the book full of interesting facts about persons, but also it discusses such matters as lengths of tenure of office, the number of meetings of Council held in different years, the attendances at them, the representation on them of different occupations, scientific and other, their administrative and legislative acts and controversies, and the finances of the Society as far back as records go.

The graph on p. 344 plots the number of fellows for each quinquennium from 1663 until 1940, and is interesting. A few years after the foundation there were some 215 fellows, about a quarter of them scientific; but by the sixteen-nineties there were only 115, the nadir in numbers. The ensuing rise went on for a hundred and fifty years, and in the early eighteen-forties the fellowship touched its numerical peak, 766. But now began to be felt the reformation of control and administration which the author calls "The Scientific Revolt, 1820-1860"; and, new elections of laymen having ceased, the total

number thenceforth fell, and so steadied down to about four hundred and sixty fellows and about forty foreign members, near which it has stayed for the past half-century.

Any serious work of history which scrupulously sets forth the evidence for its own inferences is, to some types of reader, dull. These types will be little attracted by this book; but it is not for them that Lyons wrote it. A scientific man and a careful historian, he wrote for his fellows; and perhaps above all for those who have or might have some part in the conduct of the Royal Society. There is none of such persons who should leave this work unread; it will teach them much of practical value. One of the many lessons implicit in it is that lively administration is essential to the furtherance of science but yet must be kept subservient to it. The Society has long learnt this; but it is sometimes forgotten by other planners, in their enthusiasm for logic and systems, that the best men of science are each *sui generis*, not units for regimentation, but beings for whose individual activities *qua* scientists the organization of society must elastically provide.

There is also another kind of reader who would well profit from some study of this book: namely, the general historian. For in the long run of history, thought proves more potent than engines; and the phases of the Royal Society in the past three centuries have partly reflected, but partly originated, deep changes of general thought in the nation at large, and beyond; and, without doubt, the recognition and tracing of these correlations enlightens real history.

J. I. O. MASSON.

THREE MEN OF SCIENCE

Famous American Men of Science

By J. G. Crowther. Vol. 2: Thomas Alva Edison; Josiah Willard Gibbs. (Pelican Books, A.105.) Pp. 160. (Harmondsworth and New York: Penguin Books, Ltd., 1944.) 9d.

S. Z. Ferranti

(Science in Britain Series: Published for the British Council.) By L. Randell. Pp. vi+30+4 plates. (London: Longmans, Green and Co., Ltd., 1943.) 1s. net.

IT would be difficult to select two men of science who by ancestry, upbringing, development and achievement differed more widely than Thomas Alva Edison (1847-1931) and Josiah Willard Gibbs (1839-1903), whose careers are described in Mr. J. G. Crowther's book. Of Dutch descent, Edison's forbears were physically strong, long-lived and commercial, while Gibbs came of British stock, less robust and devoted to academical studies. Of intensely practical habit of mind, Edison was given to inventing as much as Gibbs was to abstract reasoning. When during the Civil War of 1861-65 Gibbs was studying and lecturing in the seclusion of Yale, Edison, a mere boy, was selling and publishing the first newspaper printed on a train and beginning his career in telegraphy. Gibbs inherited ample means for his needs; Edison had to make his own fortune. Edison owed nothing to teachers, Gibbs everything, and from the age of twenty-six to twenty-nine was able to study under famous physicists in Europe; but both made notable contributions to scientific and industrial progress.

To understand Gibbs's work, however, a thorough grounding in scientific principles is necessary, but everyone can appreciate Edison's hundreds of inventions, his lamps, dynamos, phonographs, etc. It is impossible to compare the two men; they were as different in temperament, character and mode of living as Cavendish and Trevithick. Mr. Crowther rates Edison as "the greatest inventor recorded in history"; but that and other statements only provoke one to thought, just like the story of the members of a British scientific society who, balloting for the greatest twenty scientific men since the Renaissance, chose in order, Newton, Darwin, Faraday, Einstein and Gibbs. One of Gibbs's contemporaries who worked at thermodynamics was John Macfarlane Gray (1832-1908); but Gray was not, as Mr. Crowther says, "chief engineer of the British Royal Navy"; his official position was examiner of engineers for the Board of Trade.

In the same category of men of genius can be placed Sebastian Ziani de Ferranti, who is the subject of Mr. L. Randell's little pamphlet, one of a series dealing with British men of science and scientific institutions being published in English, Spanish and Portuguese for the British Council. Ferranti was born in Liverpool in 1864, and by the age of twenty was a manufacturer of dynamos, meters, transformers, etc. His early years were as astonishing as those of Edison, and to him more than to any other single individual is due the conception of the central super-power station generating electricity at high voltage, and its distribution over wide areas. He died in 1930, honoured throughout the engineering profession.

U.S. ANIMAL INDUSTRY

Introductory Animal Husbandry

By Prof. Arthur L. Anderson. Pp. xi+777. (New York: The Macmillan Company, 1943.) 20s. net.

BETWEEN Britain and the United States there are many differences in situation, and there is a corresponding diversity of outlook. Such differences are particularly marked in their respective livestock industries, and are historical and geographical in origin. Many of the American breeds came from the British Isles, but, in the place of stock in agriculture, in marketing arrangements, in food habits, there are great contrasts. The Englishman likes his breakfast bacon and Sunday joint, the American prefers porter-house steak, frankfurters, and (in moderation) 'Spam'. Britain is not self-sufficient in meat or animal feeding stuffs; livestock are an essential part of an intensive mixed agriculture; droughts are very inconsiderable affairs. In America there are well-defined regions—cotton, wheat and corn belts; distances are important because dairying must be within a few hours' journey of population centres; the opening up of the interior by railways led to the packing-house system.

Prof. Anderson, in the scope of his book, has been guided by a survey by his publishers. It is designed as a text-book for students beginning a college course and for reference in vocational training. Sections of approximately equal length deal with beef cattle, milking cattle, sheep, pigs, and horses and mules. References are given only to readily accessible American publications.

Animal husbandry is defined as the breeding, feed-

ing and management of domestic animals; in introducing the subject, the author is less concerned with the animals than with their position in domestic trade and the economics of their production. Thus, of ten chapters dealing with beef cattle, one is devoted to feeding and management and one to breeding: the remainder concern show-points and classes, marketing, meat grading, by-products and consumption, together with a brief historical introduction. Extensive use is made of statistics from packing-houses, U.S. Department of Agriculture surveys and the like, dealing with such matters as seasonal fluctuations in market receipts and prices, percentage losses through injury in shipment by rail or road, average live-weights at slaughter-houses, milk distribution costs, and so on. A list of slaughter-house by-products and their disposition extends to incense and oriental medicine. In contrast, no details are given of the composition of feeding stuffs, nor is there any mention of the ruminant stomach (except as tripe). Similarly, though wastage in dairy cattle is very high, there is no discussion of the causes. A curious omission is the absence of any reference to machine milking.

Housing, feeding and breeding are dealt with very briefly; a survey is given of usual practices and of economic aspects such as the price equivalents of corn and butterfat. Certain remarks on management have a very practical ring and a more than local application. Two may be quoted here: "To top the market with beef steers is the fond hope of many cattle producers. . . . It is not always related to the most profit from the feeding enterprise"; and again, of sheep: "Not all pure-bred flocks exhibit sheep at shows and expositions, but fitting for sale is essential for selling to the best advantage. Likewise a pure-bred flock manager should have salesmanship ability. The showing of a flock at the livestock shows is a form of advertising. . . ."

Prof. Anderson has aimed at the presentation of facts and the avoidance of matters of controversy. He has made much use of the findings of technical investigations. Some three hundred illustrations portray for the most part ideal breed types, industrial processes and price and population trends.

FUNDAMENTALS OF ASTRONOMY

From Atoms to Stars

By Dr. Martin Davidson. Pp. 188. (London, New York and Melbourne: Hutchinson's Scientific and Technical Publications, 1944.) 15s. net.

BOOKS written with the view of meeting the enlarged interest in astronomy manifested by the ordinary individual in recent years have not been lacking on either side of the Atlantic. One of the latest, for British readers, bears the comprehensive, if somewhat inconsequent, title "From Atoms to Stars" and is from the pen of Dr. Martin Davidson, prominent among British astronomers for his wide theoretical knowledge of the subject. To quote from the preface, it is "intended to provide a general outline of the most up-to-date knowledge of the heavenly bodies and also to show the methods employed by the astronomer to derive their distances, sizes, masses, temperatures, etc. . . ."

It is the latter aim which gives to the book its distinctive character. As if to warrant the title,

Chapter 1 is devoted to an account of the structure of the atom, according to present views, touching upon ionization, radioactivity, transmutation and allied phenomena. The reader is thus prepared for a description, later in the book, of the sub-atomic processes by which the enormous output of radiant energy continuously emitted by the sun and the stars has been maintained for thousands of millions of years.

The succeeding chapters follow the general plan adopted in books of this type. They deal in turn with the sun, the earth and the moon and phenomena relating to these bodies; next with the other members of the planetary system, including meteors and comets; and then five chapters are devoted to the stellar universe at large, in all its diversity of objects. Positional astronomy and star-configuration find no place in the book.

Each chapter contains, in addition to ample descriptive and explanatory matter, much interesting detail of a kind not commonly found in non-technical books; while in a few cases a short bibliography is appended for the information of readers who may wish to enter more deeply into the subject.

Dr. Davidson's mathematical bent finds an outlet in the fulfilment of his promise to show how astronomers tackle their theoretical problems. Many worked examples are incorporated in the text, most of them being in reality quite elementary, and some, perhaps, given at unnecessary length. This plan makes it difficult for readers to avoid the arithmetic even though they may wish merely to know the methods.

The final chapter contains a summary of various theories of the origin of the sun's planetary system, beginning with those of Kant and Laplace and concluding with several speculations of very recent date. The author is of opinion that none is really satisfactory.

A few typographical mistakes have slipped through the 'proof' stage—chiefly transposition of digits, of which the outstanding example is on page 132, where the value of a radian in degrees is stated to be $\pi/180$ instead of $180/\pi$. On pages 152, 153 "J. C. Adams" is a slip for Walter S. Adams. The director of Mount Wilson Observatory, California, is of course not to be confused with the ever-famous Prof. J. C. Adams of Cambridge, who first demonstrated the existence of the planet Neptune, which was discovered later. It is surprising, also, to find Dr. Davidson giving renewed currency to the idea that the double high tides experienced at certain places—for example, at Southampton—are due to the successional arrival of the tidal wave by two different routes. This superficially plausible explanation has been shown by such authorities as Lord Kelvin and Sir George Darwin to be fallacious.

The book is illustrated with excellent photographs and many instructive diagrams. The style is pleasantly colloquial, though a feeling sometimes arises that the author, in compressing his material, is unconsciously stepping above the standard envisaged in his preface, and is taking for granted rather more astronomical knowledge than the average reader would be likely to possess. Nevertheless, to readers with ordinary scientific outlook, "From Atoms to Stars" can be heartily recommended as an authoritative, up-to-date outline of astronomy's wonderful achievements in the exploration of the infinities both of space and time.

W. M. WITCHELL.

The Chemical Testing of Plant Nutrient Solutions
By G. S. Fawcett and Dr. R. H. Stoughton. Pp. 86.
(Salisbury: The Tintometer, Ltd., 1944.) 8s. 6d.

THE routine testing of plant nutrient solutions is undoubtedly an important part of most investigations on the soilless growth of plants, and the genuine investigator must therefore be competent to carry out the necessary chemical operations. In this book, which is essentially a set of directions for carrying out the tests, the authors have succeeded in reducing the operations to as simple a form as possible, to give speed in analysis but yet to retain an accuracy sufficient for the purpose. This result has been achieved by employing, in all cases, colorimetric or nephelometric methods which must be used in conjunction with the 'All-Purpose Lovibond Comparator' and special standard colour and turbidity disks and comparator tubes. The chemical methods have been selected from text-books and the literature, and have been adjusted and critically tested under the conditions existing in plant nutrient solutions. They provide for the estimation of the major plant nutrients and the minor and trace elements manganese, iron, boron, copper and zinc. In some cases the methods are tentative and the authors hope to improve these. As with the simplification of many chemical methods, the applicability is restricted, in this case to plant nutrient solutions only; and the authors are emphatic that all details be adhered to closely. If this advice is followed, the novice can carry out some of the tests by himself, but others involve highly corrosive chemicals; and although ample detail and space is devoted in the early part of the book to the very elementary operations of handling chemical glassware and reagents, those who are inexperienced in chemical technique should, in the opinion of the reviewer, receive a short preliminary training.

This book, together with the specially designed apparatus, should prove a great help to experimenters in the soilless cultivation of plants. R. G. WARREN.

Symposium sobre Raios Cósmicos, Rio de Janeiro, Agosto 4-8, 1941

Pp. 180+19 plates. (Rio de Janeiro: Academia Brasileira de Ciências, 1943.)

IN this volume are reprinted, in English and French, the papers given at a symposium on cosmic rays held in August 1941 at Rio de Janeiro, under the auspices of the Brazilian Academy of Sciences, on the occasion of the visit of a group of American physicists led by Prof. A. H. Compton. The scope of the conference is indicated by the following titles selected from some twenty papers: (1) "On the Fluctuations of Cosmic Rays", by A. H. Compton; a discussion of the sidereal time variation of cosmic rays. (2) "On the Latitude Effect of Cosmic Rays", by B. Gross. (3) "Cosmic Ray Studies in the Andes of Southern Peru", by N. Hilberry and A. H. Hilberry. This paper describes the determination of the variation in the frequency of extensive showers with altitude, up to 5,850 m. above sea-level, for two different counter arrays, and affords an interesting proof that most extensive air showers are initiated by high-energy electrons. (4) "Cloud Chamber Photographs at High Altitudes", by D. Hughes. (5) "The Latitude Effect for the Hard Component of Cosmic Rays and Evidence as to the Nature of the Primary Radiation", by W. P. Jesse. (6) "The Influence of a Solar Eclipse on the Cosmic Ray Intensity", by Y.

Monteux, G. Occhialini and M. D. Souza Santos. (7) "On the Ultra-Soft Component of Cosmic Radiation", by G. Occhialini and M. Schönberg. (8) "Showers of Penetrating Particles under 30 m. of Clay", by P. A. Pompeia, M. D. Souza Santos and G. Wataghin. (9) "On the Production of Mesotrons at High Altitudes", by E. O. Wollan; this interesting paper gives the results of balloon flights to determine the *multiple* production of mesons as a function of altitude. No maximum is found up to a height corresponding to a pressure of 3 cm. of mercury.

It is unfortunate that publication of this report has been so long delayed, for much of the original work presented at the conference has been published in the meantime. G. D. R.

Fitz-James O'Brien

A Literary Bohemian of the Eighteen-Fifties. By Prof. Francis Wolle. (University of Colorado Studies, Series B: Studies in the Humanities, Vol. 2, No. 2.) Pp. xi+309. (Boulder, Colo.: University of Colorado, 1944.) 2 dollars.

IN this painstaking and amply documented study Mr. Wolle follows the fortunes of a young Irishman who arrived in New York in 1852 with nothing but his wit and ready pen for luggage, and in the next ten years poured out a flood of ephemeral literature, reflecting the many facets of contemporary society. Such a chameleon could not escape the mid-nineteenth century interest in scientific discoveries and pseudo-scientific speculation. In his short stories, which rival in horror those of Poe, figure an invisible monster, a glass eye, robot killers, disembodied organs which continue to function normally, a swiftly revolving ball which is impervious to the force of gravity ("How I Overcame My Gravity"), a telepathist and, in his best-known work, "The Diamond Lens", a microscopist. This miscreant, by means of cold-blooded murder, produces the perfect lens, only to discover his ideal woman in a drop of water. Unable to make contact with her, he is doomed to watch her fade as the water evaporates. He goes mad.

Unfortunately science, in the hands of an inept surgeon, was unable to save O'Brien from the result of a pistol shot in the left shoulder, which he got while fighting with a New York regiment during the Civil War. After much needless suffering, a resection of the joint was decided on, tetanus set in, and this gifted but irresponsible Bohemian died at the age of thirty-three. Whether he would ever have fulfilled the fitful promise of his early years seems doubtful, and one wonders if it was worth while so meticulously to disinter his literary remains. They have something of a charnel-house smell, and one can only wonder at the mediocrity of a literary society in which their author ranked with the best. PHYLLIS HARTNOLL.

Studies on Immunisation

Second Series. With Appendices dealing with Antityphoid Inoculation, Chemotherapy, and Statistical and other Operations of Induction. By Sir Almroth E. Wright. (Researches from the Inoculation Department, St. Mary's Hospital, London, W.2, Vol. 4.) Pp. vii+256. (London: William Heinemann (Medical Books), Ltd., 1944.) 25s. net.

THIS volume contains selections from the published works of Sir Almroth E. Wright and his collaborators. The subjects include vaccine therapy, prophylactic inoculation against pneumonia, and other aspects of the field of immunity.

THE FORESTRY COMMISSION

THE FIRST TWENTY-FIVE YEARS

By PROF. E. P. STEBBING
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AS a result of the restrictions on imports and the heavy fellings made in the woods in Great Britain during the War of 1914-18, a Forestry Subcommittee was set up to consider the question for the country as a whole, and its report, the Acland Report, was accepted by the Minister of Reconstruction and the Cabinet as a basis upon which to frame a Forestry Bill. This Bill was passed in 1919.

The idea underlying the framing of the Bill was the necessity of making provision, against a possible future war, for a three years supply of timber and pit wood in the country. The estimated area to furnish this amount was laid down as 1,770,000 acres. This area was to be planted in a period of eighty years at a total cost of £15,000,000. During the first ten years, for which the Bill provided, an area of 250,000 acres was to be planted at an estimated cost of £2,872,500.

The chief work, therefore, of this new State Department was to bring into being a State ownership of forest land and to afforest all suitable parts of these areas; to create, in fact, national forests, a type of ownership of woods which had never previously existed in Britain. For the so-called State forests, the Dean, New Forest, and so forth, were originally, and had come down to us solely as, the personal property of the Crown. This pioneer work of acquiring land, draining, clearing, fencing and raising the plants required in nurseries and having the requisite number ready each year for the estimated areas to be planted up was by no means so easy as had perhaps been anticipated by some of the most ardent adherents of the new departure. Further, the recruitment of the indispensable trained staff proved another difficulty. Under the Forestry Bill the Commission was to receive annual grants to cover its expenditure. In forestry, a type of work necessitating the longest views, since trees do not grow to maturity in the brief space of agricultural crops, a departmental budget based on stability is indispensable. The financial crises which supervened between 1920 and 1931 had their automatic effects on checking and upsetting the annual planting plans so rigidly laid down in the Acland Report, one of its chief failings, and consequently the activities of the new department. In this connexion and owing to the inexperience of the staff, unnecessary waste was possibly incurred at these set-backs. Large numbers of plants were actually burnt in the great nurseries owing to the cutting down of the yearly planting programme; whereas there is no doubt that they could, with considerable advantage, if only in the interests of the taxpayer, have been offered at the cost of carriage to private owners of woods, as is so commonly done in Europe and, in fact, is at the present time being done in certain parts of the British Empire overseas.

In this connexion there was another serious drawback to the Acland Report, to which the Commission adhered so rigidly. The report was based almost solely on the annual planting of conifers. The valuable British broad-leaved species or hardwoods were almost entirely neglected. In fact, in parts of

Britain where poorly managed areas of coppice with standards were purchased with the estate acquired by the Commission, such was the conifer obsession that these areas after being cleared were planted with conifers; this often resulted in a heavy cleaning expenditure for a number of years to prevent the resultant coppice shoots—the natural tree flora of the locality—from smothering and killing the expensively raised and planted conifers.

It will be readily admitted that the new department had to show results, or it would have risked suppression at the hands of a lukewarm Government, House of Commons and public; and conifers are easier to raise and plant and grow more quickly than hardwoods. Moreover, the bulk of the land acquired by the Forestry Commission was conifer land.

The acquisition of the necessary land did not prove so easy. For one thing, the agricultural parts of an estate together with buildings and so forth had to be acquired; since a depreciation in values would result if only a specified portion of an estate were sold.

In the past twenty-five years the Commission has acquired approximately $1\frac{1}{2}$ million acres, of which half a million acres has been afforested and a quarter of a million acres remains to be planted. The rest of the land is either unproductive, above the present possible plantable elevation, and mountain tops, or land which is agricultural in its broadest sense and therefore does not fall within the province of the forester. These land areas now belonging to the State, that is, the public, are spread over 263 forests, of which 102 are in England, 39 in Wales and 122 in Scotland. It was foreseen that in these at present out-of-the-way-regions it would be necessary to make provision for accommodation for permanent forest workers. A programme was therefore prepared for the building of forest holdings, that is, houses each with an acre or two of land to produce vegetables and so forth; 1,500 of these holdings have been established during the period.

In England and Wales an area of 625,505 acres of land has been acquired, of which 464,178 acres is plantable land, the rest being described as agricultural holdings, nurseries, unplantable, etc. The areas planted were 276,898 acres of unafforested land and 49,102 acres of acquired woodland (the New Forest, Forest of Dean, etc., made over to the management of the Commission). The chief species used in the re-afforestation work and in planting in the acquired woodlands were Scots and Corsican pine, European and Japanese larch, Norway and Sitka spruce, Douglas fir (very popular in the early years of the Commission), oak and beech. In Scotland the total area acquired has amounted to 627,000 acres, of which 316,000 acres is plantable. The area planted has amounted to 163,000 acres, the species used being Norway and Sitka spruce, about 53 per cent; Scots and Corsican pines, about 26 per cent; European and Japanese larches, about 11 per cent; others, 10 per cent.

On the subject of private forestry, the Commission states that grants given for planting in private woodlands have been made in respect of 145,000 acres, the grant being £2-£4 per acre. Land owners, while gladly acknowledging this assistance, complained that since practical assistance by the Commission was not available, the planting-rate on estate woodlands was not much more than 6,000 acres a year, as compared with nearly double in the early years of the present century; although after

the heavy war fellings during 1914-18 the planting-rate should have been greatly accelerated. In 1914 some 97 per cent of the woods in Great Britain, amounting to 2½ million acres, were privately owned. The Commissioners claim, nevertheless, that advice on many aspects of forestry has been given to private owners. But it must be admitted that the private owners had a strong case when they maintained, first, that the new and very young State forest staff had a full-time job, increasing with the passing years; and that little time was therefore available for advice to the private owner. More than this was, however, involved; the training and experience of the staff, with no long tradition and no precedents behind them, were not always adequate to enable them to advise in the management of estate woodlands, especially the smaller ones, which presented a whole set of quite different and often very complex problems.

An interesting side-line of the work of the Commission, but a natural development, as it turns out, is the creation of three national parks on the State-owned forest land; and two more are to follow. The controversies which have taken place over the question of the afforestation of beauty spots were probably almost inevitable in a country such as Britain, with a population which knew nothing about forestry or its objectives and had lost all forest sense. That the young department may have blundered in some cases is scarcely to be wondered at. But the ignorance of the public on the subject was equally apparent.

Towards the end of the period here dealt with, the Commissioners have prepared two White Papers on post-war forestry. The first of these has had a first reading in the House of Commons.

The present Commissioners were appointed by the King, and their average length of service is now ten years. The first chairman and the man who may be said to have made the Commission was the late Lord Lovat, 1919-27; followed by Lord Clinton, 1927-29; Sir John Stirling Maxwell, 1929-32; and then Sir Roy L. Robinson, 1932 to date. Mr. Robinson was the technical commissioner to Lord Lovat and remained in the Commission in this capacity until his appointment as chairman. In the first few years, the Commission consisted chiefly of landed proprietors—to this reason perhaps may be attributed the failure to start replanting all the cut-over areas of 1914-18, since they might have been accused of helping themselves. On the other hand, it is conceded that it was due to Lord Lovat as chairman that the Commission survived the financial crises which supervened so quickly after its birth. Latterly, the Commission has had a far greater political and House of Commons flavour in its composition.

A point often raised during the past twenty-five years was the irresponsibility of Ministers and the Cabinet for the progress of forestry in Great Britain. The Forestry Commission was represented by a Commissioner, a member of the House of Commons, who acted as its spokesman. Many considered that this was far from effective; that it placed the afforestation programme of the country, a purely public matter, in constant jeopardy; that, in fact, either the business was sufficiently important to deserve the attention of, and responsibility for, a Minister of State; or the Government should give its reason for leaving the matter in the hands of a more or less autocratic authority control led solely by the Treasury. This may be said to have been the

practice at the close of the twenty-five years work. In the House of Commons on February 15 it was announced that the Minister for Agriculture and the Secretary of State for Scotland will in future be jointly responsible for forestry, the Forestry Commission being retained as an advisory body with executive functions (see p. 311).

One of the present troubles the staff of the Forestry Commission have had to deal with has been fire damage, always a serious danger with large areas of young conifers. Considerable research work into certain problems in connexion with little-known aspects of the work facing them was undertaken in the early years; for example, investigations into seed qualities, and the best regions to obtain the seed from, since so many of the species being used in the new work were exotics; nursery investigations on methods of sowing, soils, rate of growth and so forth, manuring, diseases in the nursery, both fungal and insect attacks, etc., including climatic factors, brought forth excellent results in some cases; as also the studies made of the soil flora in different regions, and growth statistics. More spectacular and easier to understand were the experiments carried out with the object of learning how to plant areas of peat land often of some depth, of which a not inconsiderable proportion of the land acquired by the Commission consisted. Sufficient here to say that great success was attained in some regions by the employment of tractor ploughing. The great increase in mechanization in connexion with farm implements of all types enabled the Commission to devise, and the makers to construct, a tractor plough of such power that areas of deep peat, hitherto beyond the ability of man to cultivate in any way, are now turned up into deep furrows and ridges, enabling drainage to be given to the area while the young trees are planted on the ridges. Continually increasing areas of such lands are being afforested, and it is a sight well worth visiting, whether from a scientific or popular point of view.

Other experiences likely to be of considerable interest to the scientific man are the investigations which have had to be taken up at short notice in connexion with pests. In the early years, great hopes were placed on the Douglas fir; but a *Chermes* appeared on it and threatened young plantations wholesale. The *Hylobius* weevil was a well-known pest, but although in Prussia chiefly confined to Scots pine, the extended work of the Commission showed that the weevil would attack several of the exotic coniferous species being used. The interest of this work lies in what is becoming a recognized factor in planting work, whether agricultural or forestry, that a large and sudden extension on a countryside will invariably be accompanied by an increase in local pests, and not uncommonly the appearance of new ones.

Looking back over the past twenty-five years, it may be said that the Forestry Commission and its officers are to be congratulated on the work which has been accomplished in spite of often difficult obstacles. The public now participate as owners in a forestry estate which with adequate support, both financial and otherwise, will form a great asset to Great Britain; always provided that the growth of the hardwoods in their respective regions is not neglected, for some of them produce the finest timber of the temperate zone, while their beauty has made English scenery as enchanting as any the world can show.

NICOTINAMIDE METHOCHLORIDE AND ITS FLUORESCENT DERIVATIVES

By DR. P. ELLINGER

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THE methylation of pyridine in the animal body was observed by His¹. When he showed that pyridine was converted to N-methyl pyridinium hydroxide and when Ackermann² found that ingested nicotinic acid was partly eliminated as trigonelline, these observations were at that time mainly of theoretical interest. They became of practical value, however, when nicotinamide was shown to be a constituent of the coenzymes I and II by Warburg and Christian³, Warburg, Christian and Griese⁴, and v. Euler, Albers and Schlenk⁵, and their significance became obvious when Knight⁶ demonstrated the importance of nicotinic acid as a growth factor in bacteria, and Elvehjem, Madden, Strong and Woodley⁷ showed the curative effect of nicotinic acid in canine black tongue and suggested its identity with Goldberger's PP factor; this fact was verified by numerous investigators. It was of considerable interest, therefore, when Najjar and Wood⁸ published their discovery that a whitish blue fluorescent substance was present in the urine of normal subjects and was increased in amount after the ingestion of nicotinamide and other related compounds.

The fluorescent material was demonstrated when a 'Decalso' adsorbate of urine was eluted with potassium chloride solution and the solution was made alkaline and extracted with butanol. The butanol extract showed fluorescence when exposed to the light of a mercury vapour bulb filtered through a Wood glass filter. In an attempt to identify the substance a large number of pyridine derivatives were examined, but none of them revealed the characteristic fluorescence when tested under similar conditions. The fluorescence spectrum in butanol was determined; a number of observations were made upon the stability and solubility of the fluorescent substance in butanol and a rough method of assay was devised by matching the fluorescence intensity of the butanol extract against that of a standard solution of quinine sulphate. Somewhat later, Najjar and Holt⁹ described a second substance that possessed a violet-blue fluorescence which became visible when the potassium chloride eluate of a urinary 'Decalso' adsorbate was extracted with butanol without adding alkali. This substance was called F_1 by the authors, while the substance observed after alkalization was called F_2 .

The pigment F_1 was found in the urines of patients in the acute stages of pellagra and of black tongue dogs in which F_2 was more or less reduced. A number of theories were put forward about the nature of F_1 and F_2 and their function, and it was suggested that F_1 might be responsible for the photosensitivity of pellagrins. The fluorescence of F_1 was also characterized by its emission band. The administration of nicotinic acid to pellagrins and black tongue dogs caused a prompt reduction of F_1 and reappearance of F_2 ^{10,11}. The nature of F_1 is still unknown. A number of pyridine and pyrazine derivatives were tested for their power to increase F_2 ; but nicotinic acid, nicotinamide and nikethamide alone were found to be active. These compounds were also known to be active in the cure of pellagra.

A violet fluorescent substance was reported by Singal and Sydenstricker¹² in the urine after ingestion of pyridoxine. The pigment is said to be present in the neutral butanol extract of a potassium chloride eluate of a urine adsorbate on 'Decalso'. Ellinger and Coulson¹³ were unable to confirm this observation, but Huff and Perlzweig^{14,15} succeeded in isolating the fluorescent material and identified it as 4-pyridoxic acid.

An attempt was made to use the elimination of F_2 by animals and man for the estimation of nicotinamide and related compounds in foodstuffs at the suggestion of Dr. B. S. Platt. For this purpose dogs, ferrets and human volunteers were calibrated with nicotinamide and a preliminary method giving comparable but not absolute values was devised for the quantitative assay of F_2 in urine^{16,17}.

In order to develop an assay method providing absolute results, it was necessary to elucidate the chemical nature of F_2 . Attempts were made, therefore, to concentrate and purify the fluorescent pigment contained in the butanol or isobutanol extracts¹⁸. The purification was carried out with the aid of the ultra-violet absorption spectrum. The absorption spectrum, the fluorescence spectrum and the behaviour of the substance towards reducing agents, alkali and acid, were so similar to those of thiochrome that F_2 was thought to be a mixture of thiochrome and a whitish fluorescent substance. Differences in the adsorption on 'Decalso' of F_2 and thiochrome at different pH's later proved that this conclusion was incorrect¹⁹.

Two papers on the chemical nature of F_2 were published simultaneously by Najjar, Scott and Holt²⁰, and by Huff and Perlzweig²¹. The former authors concentrated and purified F_2 and examined the properties of the concentrate. They observed its fluorescence in presence of alkali and acid, and recorded its stability towards oxidation; they observed the irreversible formation of a violet fluorescence after treatment with alkali and potassium ferricyanide, of a yellow pigment with green fluorescence after treatment with alkali and acetone, and of a non-fluorescent orange-red pigment after the addition of sulphanic acid. These workers proved that F_2 is a pyridine compound by producing a positive cyanogen bromide test after alkaline hydrolysis. They realized that there were similarities between F_2 and the reduction products of N-methyl nicotinamide, but were unable to identify F_2 with one of these products on account of certain discrepancies.

Huff and Perlzweig²¹ showed that animal species which were known to methylate ingested nicotinic acid eliminate increased amounts of F_2 after the ingestion of nicotinamide, while rabbits, which are unable to perform this methylation, do not eliminate F_2 after nicotinamide dosage. They claimed to have established the identity of F_2 with synthetic N-methyl-nicotinamide on the basis of the identity of the melting points and mixed melting point of the respective picrates. They concluded that " F_2 thus appears to be a N-methyl nicotinamide or a labile precursor which yields this compound in the course of isolation". Somewhat later²², they stated: "A crystalline substance was isolated from human urine after dosage with nicotinamide. From comparison with synthesised N¹-methyl-nicotinamide chloride in regard to content of nitrogen, chloride and nicotinic acid, and in regard to the absorption spectra, fluorescence, and the melting point of the picrate the two

substances were found to be identical. This establishes the identity of the fluorescent substance, F_2 , previously described by Najjar, Holt, and their collaborators²⁷. They proved that most of the trigonelline found by earlier methods in animal urine after nicotinamide ingestion was in reality nicotinamide methochloride, a fact already made probable by Sarrett²³.

Ellinger and Coulson^{19,24} also attempted to determine the chemical nature of F_2 , and examined *isobutanol* extracts that had been evaporated at 60°. The material revealed the presence of at least five different fluorescent substances which could be separated chromatographically or by fractionated sublimation. When the concentration and purification of natural F_2 or of the fluorescent derivative of synthetic nicotinamide methochloride was carried out at room temperature, however, chromatographic adsorption analysis revealed the presence of only two fluorescent compounds, which were called F_{2a} and F_{2b} .

Up to that time, it was generally believed that F_2 was eliminated in the urine as a fluorescent pigment. This erroneous conclusion was responsible for much unnecessary work and gave rise to considerable confusion, which with certain workers still persists. Keresztesy²⁵, for example, still speaks of the fluorescent F_2 , appearing in human urine. Ellinger and Coulson¹⁹ showed that when examined in the light of the 366 and 311 m μ mercury lines, neither the potassium chloride eluate of an adsorbate of urine on 'Decalso' nor that of an aqueous solution of nicotinamide methochloride is fluorescent, but that both become slightly fluorescent when made alkaline and that the fluorescence becomes more intense when the alkaline substance is extracted with *isobutanol*. Huff and Perlzweig²⁹ discriminated for the first time between the fluorescent F_2 and its non-fluorescent precursor in a paper published in 1944, in which they claim that their original investigation was concerned with the non-fluorescent precursor of F_2 and not as indicated in their earlier publications^{21,22} with the fluorescent derivative. The comparison by Ellinger and Coulson^{19,24} of a number of properties of the non-fluorescent precursor of F_2 and of synthetic nicotinamide methochloride, such as melting points of picrates and mercury iodides, absorption spectra, behaviour towards treatment with alkali and *isobutanol*, absorption and emission spectra of the fluorescent derivatives showed the complete identity of the two compounds. The only difference observed was that in the melting points of the aurates. It is to be noted, however, that aurates with different melting points and gold content were observed for trigonelline by Jahns²⁷, and, therefore, a difference of this kind cannot be accepted as indicating that the two compounds are different. A different gold content was observed, indeed, for the aurates of the natural precursor of F_2 and the synthetic nicotinamide methochloride, and three aurates could be obtained from the latter differing in colour, crystal structure and melting point (Ellinger²⁸).

The careful analysis of the behaviour of both the natural non-fluorescent precursor of F_2 and the non-fluorescent nicotinamide methochloride after treatment with alkali and *isobutanol* revealed the following facts. In aqueous solution, when examined in the beam of the 366 m μ and 311 m μ mercury lines, both substances are non-fluorescent. After the addition of alkali a weak whitish-blue fluorescence develops which can be extracted with *isobutanol* and increases

as much as 400 times in intensity when in *isobutanol*. The absorption spectra of the non-fluorescent precursor of F_2 and of nicotinamide methochloride show maxima at 264 m μ , recorded by Huff and Perlzweig²² for F_2 and nicotinamide methochloride. The absorption spectra of F_2 and of the synthetic nicotinamide methochloride derivative obtained after alkali and *isobutanol* treatment showed maxima at 358 m μ . The addition of alkali to the precursor of F_2 or synthetic nicotinamide methochloride in aqueous solution causes practically no change in light absorption.

These facts lead to the conclusion that alkalization causes a change in the nicotinamide molecule. By analogy with the findings of Hantzsch and Kalb²⁹ and of Decker and Kaufmann³⁰, a migration of the OH group from the pyridine N to one of the pyridine C atoms with simultaneous loss of one double bond in the pyridine nucleus and formation of carbinols was suggested. The low fluorescence intensity and the practically unchanged absorption spectrum in aqueous solution after alkalization showed that in water the equilibrium between the quaternary pyridinium base and the carbinols was in favour of the former, while the high fluorescence intensity and the almost complete change of adsorption spectrum in *isobutanol* indicates a reversed equilibrium in the latter solvents.

Adsorption on aluminium oxide of the purified F_2 as well as of the fluorescent derivative of nicotinamide methochloride and elution with *isobutanol* and methanol, respectively, revealed the presence in F_2 of two fluorescent compounds, F_{2a} and F_{2b} , each possessing different absorption and emission spectra. The form of their absorption spectra and the similarity with dihydro derivatives of nicotinamide described by Warburg and Christian³, Warburg, Christian and Griese⁴, and Karrer, Schwarzenbach, Benz and Solmssen³¹ lead to the conclusion that F_{2a} was probably the γ -carbinol, and F_{2b} an α -carbinol of N-methyl dihydronicotinamide. In the light usually employed, which is derived from a mercury vapour lamp filtered by Wood glass, the emission spectrum of F_2 is almost identical with that of F_{2b} , since the primary light consists mainly of the 366 m μ lines which are strongly absorbed by F_{2b} but very little by F_{2a} .

Perlzweig, Bernheim and Bernheim³² made the important observation that nicotinamide but not nicotinic acid is methylated *in vitro* by liver, but not by kidney or muscle slices of rats. Usually, but not always, this methylation of nicotinamide is increased by addition of methionine or choline. The methylation process requires the presence of oxygen and intact living cells.

Further observations on the nature of F_2 were published by Najjar, White and Scott³³, and by Najjar and White^{34,35}. In the last two communications^{34,35}, Ellinger and Coulson's¹⁹ original observations that the metabolite of nicotinamide was non-fluorescent and became the fluorescent F_2 by treatment with alkali and *isobutanol* was confirmed, whereas in the earlier paper³³ no discrimination was made between F_2 and its non-fluorescent precursor. Najjar, White and Scott³³ describe the preparation of a purified F_2 concentrate as a waxy material from which crystals were obtained by treatment with ethyl acetate, water, or methanol. A number of properties of these crystals were described. The absorption maximum of the fluorescent F_2 is described as at 264 m μ , which corresponds to that found by Ellinger and Coulson¹⁹ for the aqueous non-fluorescent precursor; the maximum for the fluorescent F_2 *iso-*

butanol solution was found by Ellinger and Coulson to be at 358 $m\mu$. Alkaline hydrolysis of the crystalline material afforded a product giving a cyanogen bromide reaction. Najjar and co-workers^{33,34,35} accept the conclusions of Ellinger and Coulson¹⁹ that the development of fluorescence from the non-fluorescent nicotinamide methochloride or the precursor of F_2 by alkalization and treatment with butanol is due to a rearrangement of the quaternary base into a carbinol, but they believe that F_2 is a carbinol-*isobutanol*-ether. This conclusion is based on the following facts: (a) that the fluorescence of the alkaline aqueous solution is greatly increased by the addition of small amounts of *isobutanol* enough to saturate the aqueous layer, but insufficient to cause a separation of the two layers; (b) that the fluorescence intensity of the *isobutanol* layer increases while standing. The carbinol-butanol-ether is said to break down when evaporated to dryness. An elementary analysis of the crystals yielded values for nitrogen which correspond to about half the amount theoretically required.

The evidence for F_2 being a carbinol-butanol-ether would appear to be inadequate, since the increase of fluorescence on addition of *isobutanol* to the alkalized aqueous nicotinamide methochloride solution is fully explained by the fact that a considerable amount of *isobutanol* favouring the carbinol phase is dissolved in water. This increase in fluorescence intensity is observed when a number of solvents of F_2 , such as methanol, ethanol, amyl alcohol, ethyl acetate (some of them being miscible with water) are added to the alkalized aqueous solution of nicotinamide methochloride or of the precursor of F_2 , but not when organic solvents are added which do not dissolve F_2 , such as ether, petrol ether, pentane, chloroform (Ellinger²⁸). The increase in the fluorescence intensity on standing is explained by the fact that the rearrangement of the quaternary base into the carbinol, induced by the equilibria in aqueous and butanol solutions and the relative solubility of the carbinol in the two layers, is a slow process. Under the conditions used in the assay method as described by Coulson, Ellinger and Holden³⁰, maximum fluorescence of the butanol layer is reached after thorough shaking for five minutes.

There is one experimental fact against the acceptance of the idea that F_2 is a carbinol-butanol-ether. The pigment F_2 can be developed by treating the aqueous alkaline solution of nicotinamide methochloride or of the precursor of F_2 with ethyl acetate in place of butanol²⁸. It seems improbable that ethyl acetate is able to form a carbinol-butanol-ether or a corresponding ether with the carbinol. The fluorescence in the ethyl acetate layer is less intense than in butanol owing to a lower partition coefficient (Ellinger²⁸).

Najjar and co-workers^{33,34,35} stress the apparent discrepancy between nicotinamide methochloride and the non-fluorescent precursor of F_2 , and employ for this purpose the findings of Coulson and Ellinger²⁴ that different aurates are formed from the two products. However, as has already been pointed out, aurates with varying gold content are formed also from trigonelline. Najjar and White³⁵ produce additional evidence in support of their conclusion that the two substances are dissimilar. The precursor of F_2 is said to show a weak bluish fluorescence, and the urinary precursor of F_2 is said to differ when different anti-pellagic agents are ingested. Reineckates obtained from urinary eluates after the ingestion

of nicotinic acid and of nicotinamide are also said to show significant differences in melting points. No crystalline picrate was obtained from the precursor of F_2 recovered after nicotinic acid administration. The weak fluorescence of the urinary precursor of F_2 would appear to contradict the findings of Ellinger and Coulson¹⁹ and of Huff and Perlzweig²⁹. The absence of any specific details of the exciting beam used by Najjar and White³⁵ makes it necessary to assume that Wood glass filtered mercury light was used, that is, a light consisting of about 90 per cent of the 366 $m\mu$ and 10 per cent of the 311 $m\mu$ lines. If the absorption spectrum of the precursor of F_2 as found by Ellinger and Coulson¹⁹ and by Huff and Perlzweig²⁹ for ' F_2 ' is correct, then the precursor of F_2 cannot be 'fluorescent' under the conditions of the experiment, since the 366 $m\mu$ and 311 $m\mu$ lines are not absorbed by the aqueous solution. The fluorescence observed by Najjar and White is probably due to impurities. Picrates possessing identical melting points have been found by Ellinger²⁸ from the precursors of F_2 after ingestion of nicotinamide, nicotinic acid, and nikethamide by a human subject. The occurrence of two different Reineckates may be due to the same cause as that of two different aurates. There is at present no evidence for the non-identity of the urinary precursor of F_2 and nicotinamide methochloride and for different F_2 precursors after the ingestion of nicotinamide and nicotinic acid.

Najjar and co-workers^{30,37} have attributed a considerable biological activity to nicotinamide methochloride. It is considered to be a growth factor for *E. coli* and *H. influenzae* and an efficient agent in preventing and curing nicotinamide deficiencies in hamsters and dogs.

The interference with the estimation of aneurin by the thiochrome method by the formation of a bluish fluorescent derivative of the nicotinamide methochloride simultaneously present during the treatment with alkali and ferricyanide was observed by Najjar and Ketron³⁸, and a method was devised to avoid this error. This bluish fluorescent pigment was called F_3 by Coulson³⁹, who considered it to be most probably a N-methyl pyridone derivative of nicotinamide. It seems probable that the same substance was obtained by Ellinger²⁸ from F_2 , but not from F_{2a} , by treatment with alkaline ferricyanide. Coulson³⁹ also devised a method for simultaneous determination of aneurin and nicotinamide methochloride.

In addition to the earlier methods, three quantitative procedures for the estimation of nicotinamide methochloride have been devised, by Huff and Perlzweig⁴⁰, by Coulson, Ellinger and Holden³⁶, and by Najjar⁴¹. With the help of these improved methods, a clearer insight was gained concerning the metabolism of nicotinamide in normal persons and its changes in certain diseases (Ellinger and Coulson¹³). Only 10-15 per cent of ingested nicotinamide is eliminated as nicotinamide methochloride in the urine by normal persons after a single ingestion; thus it must be emphasized that about four-fifths of the ingested nicotinamide cannot be accounted for³⁸. It remains to determine whether nicotinamide methochloride is the only metabolite of nicotinamide in man and animals which methylates pyridine derivatives, or whether other metabolites such as trigonelline can be found, especially after the ingestion of nicotinic acid.

Ellinger and Coulson¹³ examined the effect of the ingestion of nicotinamide, nicotinic acid and other

nicotinamide derivatives on the daily elimination of nicotinamide methochloride, studied the intrinsic and extrinsic factors influencing this elimination and discussed the mechanism of the formation of nicotinamide methochloride. From the relation of the eliminated nicotinamide methochloride to the dietary nicotinamide intake, they suspected the presence of an extra-dietary source of nicotinamide. This supposition was proved to be correct by Ellinger, Coulson and Benesch^{42,43}, who showed that a considerable proportion of the human requirements of nicotinamide can be due to the production of this substance by the intestinal flora, a fact which throws new light on the etiology of pellagra and other nicotinamide deficiencies. Nicotinamide elimination in pellagra was studied by Holt and Najjar⁴⁴, Roberts and Najjar⁴⁵ and Ellinger and Benesch⁴⁶; they found lower elimination of the F_2 precursor in pellagrins than in healthy persons, both untreated and after single and repeated administrations of nicotinamide. A change of these 'saturation curves' was also observed in certain liver diseases (Ellinger and Benesch⁴⁶). Evidence was obtained that ulcerative gingivostomatitis was not due to a nicotinamide deficiency (Coulson, Ellinger and Smart⁴⁷).

'Fluorescence' throughout this paper always means fluorescence in the visible region produced by the primary light used usually for this purpose, namely, long-wave ultra-violet, especially the 366 m μ and 311 m μ mercury lines. It is quite possible that aqueous solutions of nicotinamide methochloride emit fluorescence in the ultra-violet region when excited with rays of about 260 m μ . To investigate this point more complicated instruments, a quartz monochromator and an ultra-violet spectrograph are necessary. When fluorescence is mentioned, the absorption spectrum of the substance in question and the wave-length of the exciting beam should be given to explain whether under the conditions of the experiment fluorescence can be produced. To characterize the fluorescence qualities of a substance the 'fluorescence efficiency', that is fluorescence intensity per absorbed light quant (Wawilow⁴⁸), should be given in addition to the exciting wave-lengths and the absorption spectrum. Since absolute values of the fluorescence efficiency are difficult to obtain, it is advisable to relate the measured fluorescent intensity when half the exciting light is absorbed to that of an aqueous quinine sulphate solution of the same molar concentration under the same conditions as standard. The knowledge of the fluorescence efficiency makes it possible to judge whether changes of fluorescence intensity which occur frequently, for example, by alterations of pH, are due to a shift of the absorption band or to a change in fluorescence efficiency.

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'RUBBER ACID' DAMAGE IN FIRE HOSES

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IN a brief reference, Crosby, Fiske and Forster¹ mention that a common cause of hose failure in rubber-lined fire hoses may be due to sulphuric acid formed from sulphur present in hoses when these are not properly dried. Such damage, apparently, was almost unknown in Great Britain before the War, but has recently been much in evidence. According to Phillips², 'rubber acid' is produced, and its damage observed chiefly in fire stations which lack adequate draining and drying facilities. It would appear to affect primarily, if not exclusively, rubber-lined fire hose.

When rubber-lined hose is stored after use, without preliminary drainage and drying, there is invariably left in it a certain amount of water, and when such hose is examined during storage, it is found to contain a liquid; commonly the amount is no more than a quarter of a pint. This liquid is not infrequently discoloured brown. It is often slightly turbid and

markedly acid; the degree of acidity tends to increase with duration of storage. On examination the acid proves to be sulphuric.

When rubber acid is accidentally spilt over the canvas surface of the hose, or over any other cellulosic fabric, rapid tendering occurs, a process which becomes accelerated with the drying off of the fabric. When spilt over a concrete floor the rubber acid may cause corrosion of the floor surface and evolution of carbon dioxide gas bubbles.

Phillips² has given some data illustrating the importance of the damage caused by rubber acid to the hose, and as an immediate remedy advocated thorough draining of the hose after use. In a subsequent communication³, Phillips *et al.* describe an examination of three hundred hose bursts, representing damage throughout Great Britain. More than 50 per cent of these bursts were due to rubber acid damage. They record also that rubber-lined hose of British, Canadian and American origin are equally subject to the fault, and that the concentration of sulphuric acid found in the hose liquor may reach a figure of about 1 per cent.

Phillips *et al.* state that the opinion has been advanced that acid production is due to the inclusion in the hose rubber of an excessive amount of free sulphur, which in the presence of water and air becomes oxidized to yield sulphuric acid. However, the well-known resistance of elemental sulphur to auto-oxidation at atmospheric temperatures seemed, on the face of it, to preclude this explanation. On the other hand, micro-organisms had been observed in numerous samples of hose liquid, and since there is well-established evidence to show that in the presence of certain micro-organisms, elemental sulphur can be oxidized to sulphuric acid at atmospheric temperatures, it was logical to keep this possibility in view and to ask the Chemical Research Laboratory to examine it.

The initial samples of hose liquor were drawn under aseptic conditions from rubber-lined hoses from three fire stations in the Kingston (Surrey) district.

Details of these samples are given in Table 1.

TABLE 1.

Station	Sample No.	Appearance of liquid	Reaction of liquid to litmus	pH of liquid	Date hose last used
A	1	Colourless	Neutral	7.1	2 days previously
	2	Faintly discoloured and turbid	Neutral to only slightly acid	7.0	2 days previously
	3	Strongly yellow and turbid	Acid	1.0	At least 6 months
B	4	Colourless	Neutral to only slightly acid (about $\frac{1}{2}$ gallon)	7.0	At least 7 days
	5	Colourless and somewhat turbid	Neutral to only slightly acid (about 1 quart)	7.1	At least 7 days
C	6	Brown	Acid	1.0	At least 4 months

The presence of micro-organisms in the various samples was confirmed both by direct microscopic examination and by cultivation on ordinary nutrient agar, wort agar and thiosulphate agar, the latter being a medium free from organic substances and recom-

mended by Waksman⁴ for the cultivation of sulphur-oxidizing bacteria.

The microflora taken from the six samples of rubber acid and found capable of growth on ordinary nutrient agar comprised several forms, all of them with their natural habitat in soil and water. Their numbers ranged between two and fifteen million cells per ml. of hose liquor, except in sample 6, where they were completely absent. The highest number occurred in sample 2. None of them was of a type capable of oxidizing elemental sulphur.

On wort agar only four types of fungi developed: a black fungus so far unidentified; another with white mycelium, possibly a *Cephalosporium* species; a black *Dematium* species and a pink *Torulopsis* species. Their numbers did not exceed 70,000 cells per ml. in any of the rubber acid samples, and were no more than 20 per ml. in sample 6.

The *Cephalosporium* species was found in samples 1 and 2; the unidentified fungus in samples 3, 4, 5 and 6; the *Dematium* species in samples 1 and 4 and the pink *Torulopsis* species in sample 4. Only the black fungus, therefore, could have been associated with acid production. However, since it did not appear on any of the thiosulphate agar media, it is unlikely, to say the least, to have played a major part in sulphur oxidation.

The organisms which grew on the thiosulphate agar were restricted to no more than five types, all of them short, non-spore-forming rods. Their numbers in the various acid samples were very much of the same order, ranging from 13 to 19 million cells per ml. of hose liquor, except in sample 6 where only 5 million cells were counted.

Each of these types was tested for its sulphur-oxidizing power by inoculating it into a medium containing inorganic salts and free sulphur. On this medium only two of them, isolated from hose liquor samples 3 and 6, grew rapidly, and in less than a week rendered the liquid turbid and acid, with a drop in the original reaction of the medium from pH 4.6 to pH 1. The acid produced was identified as sulphuric acid. Of the remaining types of short rods growing on thiosulphate agar, it should be mentioned that they grew well also on ordinary nutrient agar. Those from liquors 3 and 6, which produced acid from elemental sulphur, did not do so.

The remaining four samples of hose liquid, from which sulphur-oxidizing bacteria had not been isolated by the direct method employed, were inoculated into an inorganic liquid medium containing free sulphur. It was suspected that the failure to isolate sulphur-oxidizing bacteria from these samples might have been due to their containing too few cells. By introducing the original hose liquors into a medium specially adapted for the growth of sulphur-oxidizing bacteria, it was hoped to increase their numbers and thus to facilitate their isolation. However, after incubation of the inoculated special media for 14 days at 30° C. only one of these, that inoculated with hose liquor No. 4, gave rise to acid. From this sample it was possible to isolate typical sulphur-oxidizing bacteria. The others remained unchanged in reaction and showed no growth of micro-organisms. It is probable, therefore, that these samples Nos. 1, 2 and 5 had not contained the organisms looked for.

It had been possible, therefore, to isolate sulphur-oxidizing bacteria from only 50 per cent of the hose liquors examined, implying either that these organisms may not be necessary for acid formation, or that these samples of liquors in which the organisms had

not been found, and presumably had not been present, would have failed to become acid in any event. On the available information it is not possible to decide which of the two alternatives is correct, though one deduction that can be made from the collected data seems to point in favour of the latter explanation.

The inconclusiveness of the results thus far obtained, which incidentally were unlikely to be improved upon by an analysis of further samples of hose liquor, made it desirable to test the hypothesis of a microbiological origin of rubber acid from a different angle, and to establish whether water introduced into rubber-lined hose would invariably become acid, if it contained sulphur-oxidizing bacteria.

An experiment was set up for this purpose in which tap water containing sulphur-oxidizing bacteria was introduced into sections of hose about 2 ft. long. Sections from three hoses were chosen, two from new hoses and the other from a hose already in service which had developed rubber acid. Each section was bent in the shape of a U and into each, 25 ml. of test water, containing test bacteria, were introduced. The sections were then closed with clamps to reduce evaporation and incubated at room temperature. Each section was opened daily to admit oxygen and also shaken to keep the inner rubber surface wet. As control, a sterile section was taken from each hose. Into each of these, 25 ml. of sterile tap water was introduced, but no bacteria.

Table 2 shows the rate of change in pH values of the water contained in the various sections during 14 days of incubation.

TABLE 2.

CHANGES IN pH VALUES OF WATER KEPT IN RUBBER-LINED FIREHOSES.

No.	Description	pH of water after incubation for			% of free sulphur in hose
		0 days	1 day	14 days	
1	New hose (sterile)	7.4	7.4	7.4	0.2
1a	" " " + sulphur-oxidizing bacteria	6.0	6.2	1.6	0.2
2	New hose (sterile)	7.4	7.4	7.4	<0.1
2a	" " " + sulphur-oxidizing bacteria	6.0	6.2	6.2	<0.1
3	Old hose (sterile)	7.4	7.4	7.4	0.1
3a	" " " + sulphur-oxidizing bacteria	6.0	6.4	2.7	0.1

There is an interesting deviation in the expected results tabulated in Table 2. One of the new hoses apparently did not respond as expected to the presence of sulphur-oxidizing bacteria. This was a hose in which the free sulphur present amounted to less than 0.1 per cent. Apart from this it was possible to confirm that the presence of sulphur-oxidizing bacteria is essential for the production of acid hose liquor.

In a further experiment with sections of the No. 2 new hose in which, in addition to sulphur-oxidizing bacteria, free sulphur was added to the water introduced into a sterile section, it was possible to show that the failure of acid production was due not to any inhibitory properties possessed by this hose, but to the presence of insufficient free sulphur. For in this additional experiment the pH value of the water contained in the section dropped to below 1.2 in the course of 14 days.

It is clear, therefore, that there are two factors governing acid production in hose: first the presence or absence of the relevant bacteria; and secondly,

the presence of a sufficiency of free sulphur. This latter apparently should not fall below 0.1 per cent, calculated on the rubber lining. If the figures of Table 2 may be taken as substantially correct, acid production will be proportional to the percentage of sulphur present, other factors being favourable.

The presence or absence of sulphur-oxidizing bacteria will probably be governed largely by the type of water passing through hose when in use; and it was thought relevant, therefore, to examine fire-fighting water supplies for the presence of these organisms.

On inquiry it was found that much of the water available to the National Fire Service in the London district is taken from static supplies, these being replenished from the River Thames, or from local canals and ponds. Water taken direct from the mains is not used when other supplies are available.

An analysis of twenty-five samples of water from different sources of supply, including mains water, revealed that thirteen contained sulphur-oxidizing bacteria. Only two of the samples of mains water out of six examined contained these organisms. The percentage, therefore, of the crude waters used which contained these bacteria was no less than 58 per cent. The observation may perhaps give a clue to the frequency with which rubber acid is likely to be found in hose.

The presence of sulphur in rubber-lined hoses was found on inquiry to vary very considerably. Pre-war hose specifications, according to Phillips (*l.c.*), limited the free sulphur content in hose lining to 1 per cent in Great Britain and to 1.25 per cent in the United States. But these data are not a reliable guide, for recent analyses of twelve American samples showed the content to vary between 0.06 and 0.7 per cent. Similar variations are likely to occur in hose made in Britain and in Canada. From the data given in Table 2 it would appear that a free sulphur content of 0.1 per cent is sufficient to produce some acid, and that 0.2 per cent causes marked acid production. A permitted minimum of 1 per cent of free sulphur is therefore a gross excess, and can be expected to lead to acid production whenever the appropriate bacteria are present.

Conclusions. The conclusions to be drawn from the experiments which have been carried out would appear to be that:

The production of rubber acid in hose is due to the activity of sulphur-oxidizing bacteria of the *Thiobacterium thiooxidans* group.

Such acid will invariably be formed in rubber-lined hose which is stored with the linings wet, when the responsible bacteria are present and when the free sulphur content of the hoses exceeds 0.1 per cent.

If acid production is to be prevented, it is necessary to ensure, either that the rubber-lined hose is stored dry, or that its content of free sulphur is less than 0.1 per cent.

The alternative of preventing the introduction of the causal bacteria does not appear practicable, since the water used in fire-fighting is a frequent habitat of these bacteria.

In a series of additional experiments it was established that various organic sulphur compounds, commonly used in the vulcanization of rubber, failed to give rise to acid production, even in the presence of sulphur-oxidizing bacteria.

Thanks are due to the officers and men of the National Fire Service, and especially to Company Officer W. E. Gage, Hose Officer, No. 38 Fire Force,

who assisted us in obtaining the necessary experimental material and certain data required for this investigation. The work was carried out on behalf of the Director of Scientific Research, Ministry of Home Security, and is published with the approval of the Department of Scientific and Industrial Research and the Ministry of Home Security.

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OBITUARIES

Lord Dawson of Penn, P.C., G.C.V.O., K.C.B.,
K.C.M.G.

THE death on March 7 of Lord Dawson at the age of seventy-nine has removed from the ranks of the medical profession one of its most eminent members. Lord Dawson symbolized in his own person the many different services the profession can render to the community. He had been physician to several members of the Royal Family. He was the perfect consultant combining hospital appointments with private practice, always at the service of his patients at whatever inconvenience to himself. To the House of Lords, to which he was elevated in 1920, he brought fine qualities of statesmanship and oratory, and he did invaluable work there in presenting to the public the medical point of view. His scientific eminence was reflected in the many honours conferred on him by universities and medical societies all over the world.

Lord Dawson was a prolific writer and lecturer on a wide variety of medical subjects. He took a prominent part in the organization of the medical services and the famous Dawson Report, produced under his

chairmanship by the Consultative Council on Medical and Allied Services appointed at the time of the creation of the Ministry of Health in 1919, is a milestone in the history of medical services. If the Government had acted upon the advice offered in that Report we might have been saved many of the problems the profession is facing to-day. Lord Dawson's wisdom in guiding the domestic affairs of his profession was recognized by his election to the presidency of the Royal College of Physicians during 1931-38 and to the presidency of the British Medical Association in its centenary year in 1932. He was recalled to the presidency of the British Medical Association in 1943 to lead the profession in the present critical stage of the development of the medical services of Great Britain.

To all his work Lord Dawson brought a rare vigour and wisdom and sympathy. He saw the practice of medicine as a means of making people healthy and happy. His charm and courtesy endeared him to all with whom he came in contact, both professionally and socially, and his pervasive influence will be sorely missed by the medical profession and the scientific world.

WE regret to announce the following deaths:

Sir Charles Bell, K.C.I.E., C.M.G., an authority on Tibet, aged seventy-four.

Sir George Humphreys, K.B.E., formerly chief engineer to the London County Council, president in 1930 of the Institution of Civil Engineers, on March 9, aged eighty-one.

Sir Hanns Vischer, C.M.G., C.B.E., honorary secretary-general of the International Institute of African Languages, on February 19, aged sixty-eight.

Prof. H. H. Whetzel, professor of plant pathology in Cornell University, on November 30, aged sixty-seven.

NEWS and VIEWS

Helium for the Royal Society Mond Laboratory

THE National Research Council of Canada has recently made a gift of 2,000 cubic feet of helium gas to the Royal Society Mond Laboratory at Cambridge. This amount of gas will enable the Laboratory to recommence research on very low temperature problems and on a scale which will allow the full resources of the Laboratory to be employed. In the whole field of physics, the temperature region close to the absolute zero remains one of the most fruitful for investigation. The low-temperature problems which received most attention before the War were those of superconductivity, magnetic cooling and the properties of liquid helium itself. These are, however, only the more prominent aspects of a wider field of investigation. Many mechanical, electrical, magnetic and optical phenomena, which are either partially or completely obscured by thermal agitation at room temperature, stand out clearly and undisturbed in the quiet region from 5° absolute down to 0·01° absolute which is attainable with liquid helium.

Grants for Scientific Investigations and Publication

THE Royal Society has now been informed that the Treasury has made provision in the estimates for the fiscal year 1945-46 for the following grants which are

administered by the Royal Society: for scientific investigations, £14,000; for scientific publication, £7,000; for scientific congresses, £1,600. In view of the greater amounts to be available if these estimates are accepted by Parliament, and of present changing conditions, the Royal Society has decided that more frequent allocation is desirable. The last dates, therefore, in 1945, for receiving applications for grants from the Parliamentary Grant-in-Aid for Scientific Investigations will be March 31, July 31 and November 30, and the last dates for receiving applications for grants from the Parliamentary Grant-in-Aid for Scientific Publication will be June 15 and November 15.

Cosmic Ray Studies in the Pamirs

A GROUP of scientific workers from the Lebedev Institute of Physics, Moscow, has left for the Pamirs to study the composition of cosmic rays at high altitudes. The expedition is under the direction of Prof. Skobeltsyn, of the U.S.S.R. Academy of Sciences, and will continue studies that have been carried on for several years on Mt. Elbrus by workers from the Atomic Nucleus Laboratory. The main object of the expedition is to determine the part played by heavy particles and secondary mesons first discovered in the study of cosmic radiations in 1937. Cosmic

radiations have two sharply defined components—a hard component consisting of mesons possessing great energy and a soft component including positrons and electrons. It is known that the soft component, at any rate at sea-level, is genetically connected with the hard component, being apparently generated by the latter. At great altitudes the presence of an unbalanced component has been discovered, namely, radiation that is not directly connected with the hard component. The study of cosmic radiations at great heights is therefore of great importance for the understanding of cosmic radiations as a whole. The question of secondary mesotrons and other strongly ionized agents causing ionization impulses is of great interest. The problem of the generation of secondary mesotrons has gained in significance in recent times.

In order to study mesons, the expedition will make use of an improved form of 'proportional telescope'. In studying cosmic rays at great heights, they will take into consideration 'atmospheric rain', a phenomenon of cosmic rays discovered by a French physicist, P. Auget. Skobeltsyn has studied all the available experimental data, especially those obtained in the Elbrus Laboratory, and has come to the conclusion that a considerable proportion of the impulses are due to processes other than 'Auget's rain'. The expedition will try to prove this by the method of coincidences. An important part of the work of the expedition will be the study of the transition effects of the soft component, that is, the processes which occur when rapid protons and electrons leave matter with one atomic weight and enter the orbit of substances with a different atomic weight. The cycle of studies devoted to these particular effects, which was begun before the War, will be continued, employing greatly improved methods which the Atomic Nucleus Laboratory has recently evolved.

Educational Needs in Liberated Countries

THE sixteenth meeting of the Conference of Allied Ministers of Education was held on March 7 under the chairmanship of the Right Hon. R. A. Butler. The Belgian Minister of Education, M. Buisseret, made a special visit to London in order to attend. Mr. Butler stated that considerable progress has been made towards the establishment of a United Nations organization for educational and cultural reconstruction, and it was announced that it would be possible, after the San Francisco meetings, to make proposals for the final constitution of the new organization. M. Buisseret presented a statement to the Conference stressing the difficult position which has resulted from the Nazis' forceful educational propaganda among teachers and in schools, especially in the small, mainly German-speaking areas of Belgium, which in the course of the occupation had been annexed to Germany. It was pointed out that similar problems might arise in other countries which had suffered occupation. The Conference was informed that a new Commission has been formed "to collect information from liberated countries and elsewhere about the educational needs of, and the work being done for, children and young people requiring special educational treatment; to make the necessary contacts with other bodies engaged on similar activities and to make recommendations to the Conference as to how the information can best be made available and assistance given if desired to the Allied Governments". Mr. J. A. Lauwerys has been appointed to direct the inquiry, and will have his headquarters at 3-5 Salisbury Square, London, E.C.4. The Con-

ference adopted the following resolution, and decided that it should be communicated to the Allied Governments through their delegations: "The Conference of Allied Ministers of Education, having considered reports from liberated territory, record their unanimous view that the need for the supply of raw material for educational purposes, and in particular for school books, is of paramount importance. Unless such supplies are made available the Conference believes that the resumption of educational activities will be greatly delayed and additional hardship for the children, students and parents in liberated territories will result."

Restoration of Libraries

UNDER the auspices of the Conference of Allied Ministers of Education, a committee has been set up to administer the organization and premises known as the Inter-Allied Book Centre, 3-5 Salisbury Square, London, E.C.4, where books can be received and systematically arranged for ultimate allocation to libraries in Great Britain and abroad which have been damaged or destroyed during the War. Already more than a million books, ranging over the whole field of knowledge, have been set aside, by action of the Government, from collections made primarily for salvage purposes. The collection includes books of every kind; but the proportion of modern technical, scientific, commercial and legal works is low. Many libraries will urgently need sets of the more important periodicals, particularly the back numbers of journals and transactions. Those unable to give books or periodicals can support the general scheme by money contributions, which will be used entirely for the purchase of books and periodicals; but so many books have been destroyed, or are in short supply, that the need is for books rather than money. It is generally thought that the committee of allocation should have a free hand to decide the ultimate destination of all books received; but if a donor urgently desires to give to a particular country, or even a particular library, he is asked to communicate with the director of the Book Centre. Bodies which are already collecting books for specific countries or institutions are asked to supply the director with lists of books and periodicals which they propose to distribute, so that they can be taken into account by the Centre in making its own distribution. Donors are asked to send to the director of the Centre, Mr. B. M. Headicar, lists of the books available; carriage will be refunded, if desired, on all books presented.

Royal Institute of Chemistry

AT the sixty-seventh annual general meeting of the Royal Institute of Chemistry held on March 12, at the Institute, 30 Russell Square, W.C.1, Prof. Alexander Findlay, the president, in moving the adoption of the annual report, emphasized the growing opportunities for men of science to bring about a better balance between science and politics and between knowledge and power. The tasks of Government and the formation of a national and international policy which will secure the fullest and most complete development and expression of human nature, when beauty and goodness merge and blend together with truth, depend in part on values other than the scientific, and involve problems which cannot be solved merely by the application of the laws of natural science. But in securing the material well-being of the people and in advancing industrial pro-

perity, science is all-important and, in Prof. Findlay's opinion, representatives of scientific institutions on the Parliamentary and Scientific Committee are playing a particularly important part in keeping the Government informed regarding the discoveries and applications of science to human and industrial well-being, and in providing a scientific method of approach to the problems of national administration, a method infused with the spirit of truth rather than of prejudice or party partisanship.

Prof. Findlay stated that the roll of membership of the Institute has increased by 523 to 9,227, and the register of students by 205 to 1,225 during the past year. He also referred to the greater collaboration among the various organizations of chemists and the better co-ordination of their activities, in which representatives of the Institute have continued to play their part. He congratulated the Chemical Council on having gained from industrial firms and private subscribers greatly increased financial support for chemical publications. During the sixty years since the Institute was incorporated by royal charter, its membership has increased twenty-fold and there has also taken place remarkable expansion of the activities of chemists. The time has now come to reformulate its aims and interests and to adapt its organization so as the more effectively to achieve its aims and fulfil its responsibilities; proposals for modifying the charter and by-laws are to be laid before the members in due course. Reference was made to the retirement of Mr. Richard B. Pilcher, who had been secretary for fifty years and for forty-five years registrar and secretary, and the appointment of Dr. H. J. T. Ellingham as secretary and Mr. R. L. Collett as registrar. Prof. Findlay was re-elected president.

Pedigree of Fossil Man

PROF. RUGGLES GATES has produced a very concise and interesting article on the pedigree of fossil man (*Amer. J. Phys. Anthropol.*, 2, No. 3; Sept. 1944). He reviews the opinions of others, discusses modern tendencies and viewpoints, and summarizes his own conclusions. So long as the data supplied relative to the finds of prehistoric man are reliable, the conclusions arrived at by the physical anthropologists must, of course, be treated with great respect. But unfortunately, really well-authenticated and documented discoveries of prehistoric skeletons are more than rare. For example, Prof. Ruggles Gates says: "The evidence of the Committee which investigated the Swanscombe parietal and occipital shows that stratigraphically it is one of the best authenticated of all human remains, and geologically the evidence of the age of the gravels in which they were found is very complete". In the sense that the exact horizon whence came the bones is known, this is certainly true; but it is not enough, for in those Swanscombe gravels both Acheulean and Clactonian industries occur mingled. To say the least, it is still possible that the prehistoric folk who made the *coup-de-poing* industries were entirely distinct from those flake-tool makers who produced the Clacton, Levallois and other flake industries. A study of distribution maps strongly suggests that such a distinction should be made. Now the early flake-tool folk were the ancestors of the Mousterians, that is, of Neanderthal man, whereas the *coup-de-poing* makers appear to have quite another story—perhaps an African one—and it is thus still impossible to be certain to which of these two cultural facies the Swanscombe bones belonged. It is not until problems like this—

purely matters for the prehistorian to settle—are resolved that the physical anthropologist can satisfactorily do his job. Bearing in mind this warning note, Prof. Ruggles Gates's paper makes interesting and informative reading. He is trying to give answers to just those questions many would like to have elucidated; among other interesting conclusions he places Neanderthal man, in accordance with Weidenreich, in the chain of development from *Pithecanthropus* and *Sinanthropus* to "the modern type of man". Not all anthropologists would agree.

Length of Small Intestine

THE capacity of the human body to withstand remarkable injury or loss of what may seem to be essential organs is continually astonishing those who have to deal with injuries sustained in war and peace or with the results of surgical operations. C. C. Holman (*Lancet*, 597, Nov. 4, 1944) has reported the instance of a woman who, having survived the removal of her uterus and of the breast for cancer ten and six years earlier respectively, had to sustain, at the age of fifty-six, the removal of twenty feet of her small intestine: a lateral anastomosis was performed between the jejunum and the transverse colon. The patient recovered and three months later had gained 2 lb. in weight. A year after the operation she weighed rather more than before her operation and was doing the parish work as a clergyman's wife.

In an Annotation on this case, the *Lancet* says that people have survived, for several years at least, with only 3 ft. of combined duodenum and jejunum and no ileum. It has been calculated (H. E. Haymond, *Surg. Gynec. Obstet.*, 61, 693; 1935) that removal of up to one third of the total length of the small intestine could be followed by return to normal function; but that poor results might follow removal of more than half of it, or eleven feet in average people. It is pointed out, however, that the length of bowel removed gives no true indication of the length which remains, because the total length of small intestine varies between 10 ft. and 28 ft. 4 in., according to J. Bryant (*Amer. J. Med. Sci.*, 167, 499; 1924), who measured the small intestine at autopsy in 160 adults. When the gut is alive, it is a great deal shorter, possibly half the length measured at autopsy or less. Another case, reported by J. A. Cosh in the same issue of the *Lancet* (p. 596), was less fortunate. This was a man aged sixty-seven, from whom all the small intestine was removed except the duodenum and about 3 ft. of the jejunum. For about eight months he had fairly good health, but then became ill and died twelve months after the operation.

Announcements

PROF. BENGT EDLÉN, of Lund Observatory, Sweden, has been awarded the Gold Medal of the Royal Astronomical Society for the year 1945 for his identification of the origin of the principal lines in the coronal spectrum.

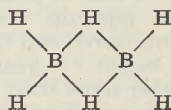
THE Council of the University of Sheffield has appointed Dr. Harry Moore to the chair of glass technology in succession to Prof. W. E. S. Turner, who is to retire at Christmas 1945; Dr. H. A. Krebs to the newly created chair of biochemistry; and Mr. A. E. Bender to be research biochemist in the Department of Pathology, to work in association with the Sheffield Radium Centre.

LETTERS TO THE EDITORS

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

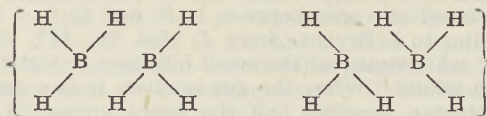
Structure of Boron Hydrides

As¹ recently shown², the interpretation of polyatomic structures does not require the hypothesis of resonance among several idealized valence-bond structures, a speculative application of the quantum-mechanical conception of resonance, which is in disagreement with numerous facts. They are accounted for by the principles of the classical (atomic and electronic) structural theories. The boron hydrides have been represented as resonance hybrids involving structures with one-electron linkages. Longuet-Higgins and Bell², in a most interesting and important discussion, have given convincing evidence that the introduction of the unique and theoretically unlikely one-electron linkage between two unequal atoms is unnecessary, and that the boron hydrides should be represented by the bridge formulæ of type



containing hydrogen bonds³.

Since hydrogen bonds are generally formed between atoms with unshared electrons and hydrogen atoms belonging to strongly polar linkages, whereas no unshared electrons are available at the B atom and the B—H linkage may be only slightly polar, Longuet-Higgins and Bell prefer to distinguish the linkages in the boron hydrides from other hydrogen bonds as resonance links. This implies a stabilization due to resonance involving no electron linkages. It is assumed that electrons belong to the orbitals of more than two atoms, that is, are non-localized.



However, two factors should be essential for the formation of the electrostatic hydrogen bond: (1) presence of opposite charges at the two atoms; (2) the possibility of a sufficiently close approach of the atoms. Decreasing size of the atoms and absence of other atomic orbitals sterically inhibiting the approach of the second atom will facilitate the formation of a hydrogen bond. Such favourable conditions exist particularly in the case of small and unshielded atoms such as H, B, F, O, etc.; the presence of unshared electrons is incidental. The charges at the B and H atoms in boron hydrides may be small; but this could easily be compensated by the presence of two linkages and the rather short B . . . H distances, which should not be longer than 1.6 Å.

It is not justifiable to assume that the H atom in BH₃ is unlikely to form a hydrogen bond of an essentially electrostatic nature with the B atom of another molecule, because this ability decreases rapidly in the series HF, H₂O, H₃N, H₄C. The charge at the H atom being positive will decrease in the former three molecules to become negligible, although possibly already negative in CH₄⁴. Certainly in BH₃

it should be negative* and again greater. Moreover, in contrast to the completely shielded C atom in CH₄, the B atom, like the F, O, and N atoms, will allow the approach of another H atom.

The formation of stable ring structures rather than of long-chain structures by hydrogen bonds will depend on steric influences, including the ability of the participating atoms to form sufficiently strong linkages at the angles required. Steric conditions being satisfied, ring structures of smallest polymerization degree will always be more stable because of the increased stability due to an additional hydrogen bond and an increased polarization of the linkages involved. Thus, carboxylic acids possess a dimer ring structure, *ortho*-nitrophenol and numerous similar substances form intramolecular rather than intermolecular hydrogen bonds.

The formation of an electrostatic linkage will, of course, not only depend on the size of the atoms essentially determining the interatomic distance, but also on the degree of their charges, which will increase in the series (+)B—H(−) < (+)Al—H(−) < (+)Ga—H(−) and compensate for the lengthening of the interatomic distance.

The interpretation of the unexpectedly complicated infra-red spectrum of diborane has offered considerable difficulty⁵. An analysis based on the suggested structure containing different covalent B—H and electrostatic B . . . H linkages should be of interest. However, a decision between these structures is only possible by a comparison of analyses based on both the 'symmetrical' and the 'unsymmetrical' bridge structure.

The stability of boron hydrides does not require the introduction of a new type of resonance involving no electron linkages.

A. BURAWOY.

College of Technology,
Manchester.

Dec. 21.

* During a discussion following a lecture by Mr. R. P. Bell on November 30, Prof. J. Kenner independently directed attention to this point and emphasized its importance in relation to this problem.

¹ Burawoy, *Trans. Far. Soc.*, 40, 537 (1944); *Chem. and Ind.*, 434 (1944); cf. also Burawoy, *Trans. Far. Soc.*, 39, 79 (1943); *Chem. and Ind.*, 855 (1940). Samul, *J. Chem. Phys.*, 12, 167, 180, 380 (1944).

² Longuet-Higgins and Bell, *J. Chem. Soc.*, 250 (1943).

³ For original literature, see ref. 2.

⁴ Timm and Mecke, *Z. Phys.*, 98, 363 (1935). Fuchs and Wolf, "Dielektrische Polarization", *Hand- und Jahrbuch der Chem. Phys.*, 356 (Leipzig, 1935). Trieschmann, *Z. phys. Chem.*, 32B, 22 (1936). Cf., however, Smyth, *J. Phys. Chem.*, 41, 215 (1937).

⁵ Stitt, *J. Chem. Phys.*, 9, 780 (1941).

THE chief contention put forward in our earlier paper was that in diborane and similar molecules there were pairs of hydrogen atoms which occupied a special position in linking together different parts of the molecule. We agree with Dr. Burawoy that the formulation of these links as resonance hybrids represents only one way of describing this state of affairs: for example, a molecular orbital treatment of the system would not involve the use of the resonance concept. On the other hand, we doubt whether this linkage can be regarded as an electrostatic 'hydrogen bond' of the type met with in HF, H₂O and NH₃. The tendency to this type of dipole association decreases rapidly along the series FH, —OH, >NH, C≡H, and it would be remarkable if it appeared again to a high degree in >BH. It is, of course, conceivable that the BH link has a considerable dipole with the negative end on the hydro-

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(Incorporated by Royal Charter, 1885)

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A Register of Chemists (Fellows, Associates and Senior Registered Students), who are available for appointments or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to The Registrar, the Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

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Forms of application are obtainable from: The Honorary Secretary, Cooper Centenary Fellowships for Veterinary Research, 40 Westminster Palace Gardens, Westminster, London, S.W.1.

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Further particulars of the appointment may be obtained from the Principal upon the receipt of a stamped addressed envelope.

H. S. MAGNAY,

Director of Education,
Education Dept.,
Newarke Street, Leicester.

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City Hall,
Cardiff.

W. J. WILLIAMS,

Director of Education.

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Principal: C. Chew, M.Sc.Tech., F.R.I.C.
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Further particulars and form of application, to be returned not later than April 7, may be obtained by sending stamped addressed foolscap envelope to the Director of Education, Education Offices, Leeds, 1.

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Applications, stating qualifications and experience, should be lodged with the undersigned not later than March 31.

13 George Square,
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THOMAS BLACKBURN,
Secretary.

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Applicants should write, quoting F.3408A, to the Ministry of Labour and National Service, Appointments Dept., Central (T. & S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2, for the necessary forms which should be returned completed on or before April 10, 1945.

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(University of London)

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(University of London)

Camden Hill Road, London, W.8.

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THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

A vacancy in the Chair of Agricultural Chemistry has occurred owing to the resignation of Prof. D. N. McArthur, D.Sc., Ph.D., F.R.I.C. Candidates are requested to apply for particulars of Conditions of Appointment to the undersigned.

Applications are to be lodged with the subscriber on or before April 6, 1945.

A. J. WILSON,
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Applications for employment as Technical Assistants are invited from men and women under 22 years of age with Higher School Certificate or Intermediate B.Sc. in physics, and/or maths, for analysis and reporting of aircraft vibration development and research tests. Salary not less than £2 10s. per week at 18 for either sex, plus Federation Scale of war bonus. Experience not necessary. No appointments will be made until all relevant restrictions covering such engagements are withdrawn, except in the case of women not covered by the Employment of Women (Control of Engagement) Orders, 1942-3.—Reply, Box 823, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

The Royal Photographic Society of Great Britain invites applications for the post of Assistant Secretary, with a view to promotion to Secretaryship of the Society. Commencing salary £750, or according to qualifications. Consideration will be given to applicants who, owing to wartime duties, cannot take up the post immediately.—Applications, which will be treated in confidence, should be accompanied by full particulars of qualifications and previous experience, and addressed to the Royal Photographic Society, 16 Prince's Gate, London, S.W.7, and the envelope marked "Assistant Secretary."

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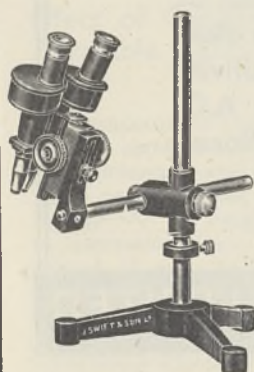
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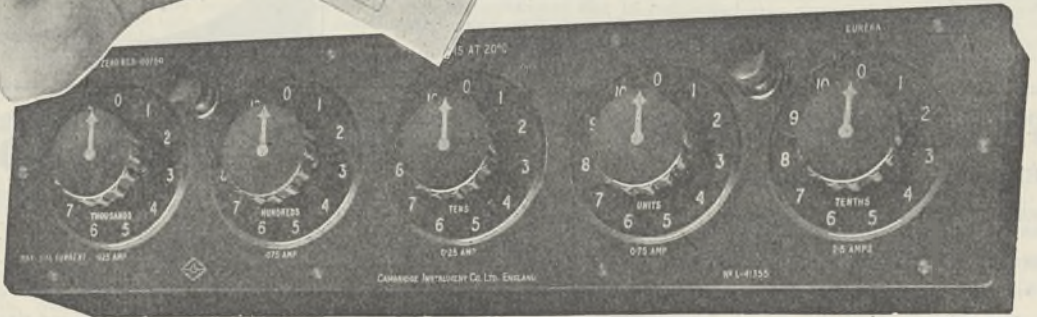
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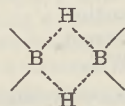
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gen atom, but it is not likely that this would lead to the formation of a stable dimer showing no tendency to further polymerization. A much more likely result would be the formation of an indefinite series of polymers, as is the case with H_2O , HF and NH_3 . It is improbable that the small size of the boron atom is a determining factor, since the hydrogen compounds of aluminium and gallium dimerize as well as those of boron.

If B_2H_6 did contain electrostatic hydrogen bonds, the two central hydrogen atoms would not be equidistant from the two boron atoms. As Dr. Burawoy suggests, information on this point might be obtained from the vibrational spectrum of diborane, though the differences in symmetry involved are not such as to produce markedly different selection rules for the symmetrical and unsymmetrical models. However, we have recently made detailed calculations of the normal vibrations of a B_2H_6 molecule contain-

ing a symmetrical bridge



obtained excellent quantitative agreement with the observed infra-red and Raman spectra¹. This agreement makes it unlikely that the central hydrogen atoms are unsymmetrically placed.

R. P. BELL.

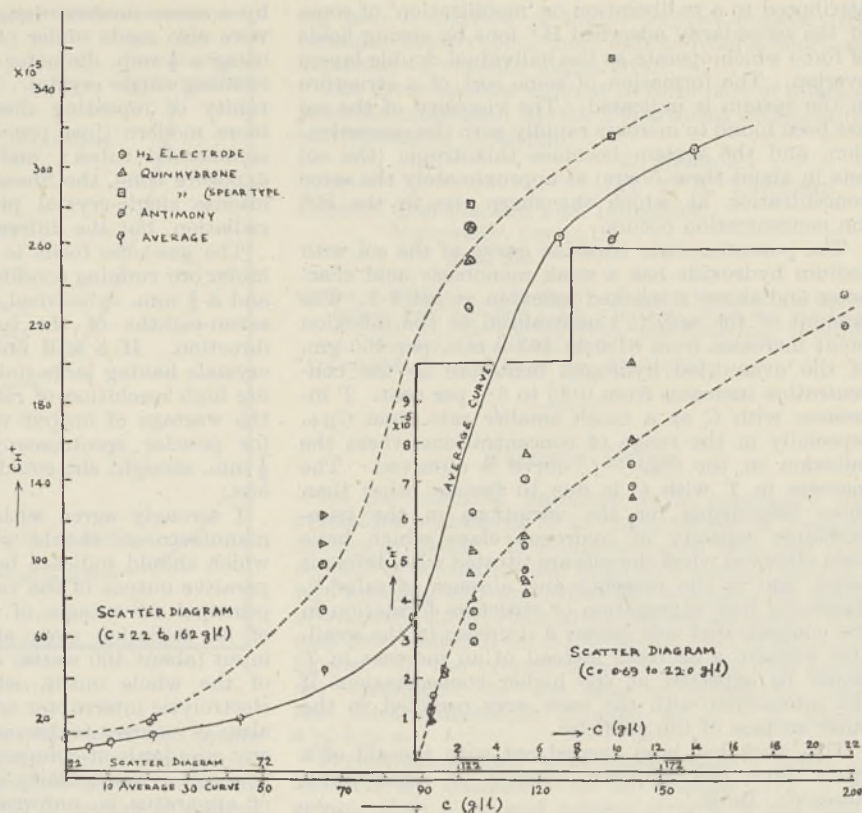
H. C. LONGUET-HIGGINS.

Physical Chemistry Laboratory,
University, Oxford.

¹Details will appear shortly in *Proc. Roy. Soc., A*.

Effect of Concentration on the Free and Titratable Acids of Hydrogen Bentonites Sols

HYDROSOLS of hydrogen clays and hydrogen bentonites show a marked acid character and give potentiometric and conductometric titration curves with bases having definite inflexion points and breaks^{1,2,3}. A linear relation between the H^+ -ion concentration C_{H^+} , and the concentration of the colloid, C , was observed by Wiegner and Pallmann⁴ in the case of dilute sols having concentrations up to about 0.3 per cent. At higher concentrations the slope, dC_{H^+}/dC , progressively decreased. Some interesting effects of the concentration of the sol on the H^+ -ion concentration of the sol as well as



the amount of the acid calculated at the inflexion point of the potentiometric titration curve with sodium hydroxide have been observed in the case of a hydrogen bentonite, Kashmir-B, isolated from a deposit of bentonite in Kashmir. X-ray analysis showed that Kashmir-B did not probably contain any mineral other than montmorillonite⁵.

Hydrogen, quinhydrone and antimony electrodes were used for measuring the pH. A 'spear type' quinhydrone electrode prepared as described by Sanders⁶ was also used in the case of very concentrated sols and pastes.

Several determinations of the pH were made at each concentration. These are shown on the accompanying scatter diagrams drawn separately for two ranges of concentrations, 0.069-2.2 per cent and 2.2-16.2 per cent. The full curve shows the average C_{H^+} at the various concentrations.

C_{H^+} increases almost linearly with C until the latter attains a value of about 0.2 per cent. Beyond this point, and up to a concentration of about 2 per cent, the slope, dC_{H^+}/dC ($= \alpha$), gradually diminishes. A sudden decrease in the cataphoretic velocity and a rapid fall of the equivalent conductivity were previously observed⁷ at a concentration of about 0.2 per cent of the same hydrogen bentonite sol.

The slope, α , increases at concentrations higher than 2 per cent, and a steep rise and an inflexion in the $C_{H^+} - C$ curve is observed at a concentration of about 10 per cent. Beyond this concentration the slope again decreases.

The progressive decrease in α at moderate concentrations possibly indicates a secondary adsorption of increasing numbers of mobile H^+ ions of the double layer⁸. The increase in the slope and the inflexion observed at higher concentrations are to be

attributed to a re-liberation or 'mobilization' of some of the secondarily adsorbed H^+ ions by strong fields of force which operate as the individual double layers overlap. The formation of some sort of a structure in the system is indicated. The viscosity of the sol has been found to increase rapidly with the concentration, and the system becomes thixotropic (the sol sets in about three hours) at approximately the same concentration at which the sharp rise in the H^+ ion concentration occurs.

The potentiometric titration curve of the sol with sodium hydroxide has a weak monobasic acid character and shows a marked inflexion at pH 8.5. The amount of the acid (T) neutralized at the inflexion point increases from 81.0 to 103.0 m.e. per 100 gm. of the oven-dried hydrogen bentonite as the concentration increases from 0.25 to 8.8 per cent. T increases with C at a much smaller rate than C_{H^+} , especially in the range of concentrations where the inflexion in the $C_{H^+} - C$ curve is observed. The increase in T with C is due to factors other than those responsible for the variations in the base-exchange capacity of hydrogen clays which have been observed when the sols are titrated with different bases, and in the presence and absence of salts^{9,10}. Assuming that aggregation or structure formation in the concentrated sols causes a decrease in the available surface, a decrease instead of an increase in T would be expected at the higher concentrations if the interaction with the base were confined to the outer surface of the particles.

This work has been carried out with the aid of a grant from the Imperial Council of Agricultural Research, India.

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by a more modern design. The tests I carried out were also made under particular conditions, that is, using a $\frac{1}{2}$ mm. diameter cylindrical collimator and a rotating single crystal. I have since had the opportunity of repeating these and other tests using a more modern (just pre-war) Philips tube and other commercial tubes; and I find that, in the same exposure time, the Shearer tube still gives the most intense single-crystal photograph using copper K radiation, but the difference is smaller.

The gas-tube focus is (as used in projection, and under our running conditions) about 2 mm. \times 1 mm., and a $\frac{1}{2}$ mm. cylindrical slit therefore wastes at least seven-eighths of the tube output in the required direction. If a still finer slit were to be used for crystals having large unit cells and therefore requiring high resolution of reflexions on the photographs, the wastage of output would be even greater; but for powder spectroscopy, for which a 2 mm. \times $\frac{1}{2}$ mm. straight slit could be used, it would be much less.

I strongly agree with Sir Lawrence Bragg that manufacturers should give some 'figure of merit', which should indicate both focal spot size and comparative output of the various tubes now made. The principal advantages of the gas-tube are the purity of its radiation even after long running, the low input (about 400 watts) and the very low initial cost of the whole outfit, when an induction coil and electrolytic interrupter are used. These factors ought also, of course, to be considered in connexion with any standards of comparison that might be adopted. The cost is particularly important, because the price of apparatus is, unfortunately, a serious and sometimes crippling consideration with research workers in general.

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¹ "X-Ray Equipment for Crystallography", *Nature*, 155, 244 (1945).

The Cool-Flame and Two-Stage Ignition Systems in Ether - Air Mixtures at Room Temperature

THE normal and cool-flame systems in diethyl ether - air, etc., mixtures have been defined by means of diagrams showing the influence of pressure on their respective ranges of inflammability¹. Whereas the normal flame range centres upon approximately the theoretical mixture or that capable of developing the highest flame temperature and consequent flame speed, the cool-flame range appears to centre upon the mixture giving rise to the fastest reaction in slow combustion. High-tension sparks are employed for igniting the normal flames, but a suitably heated element must be used for the cool flames. If the experimental pressures in the cool-flame range be increased, pressure-composition limits may also be defined for the initiation of a second-stage 'blue' flame in the cool-flame products; this arises from the autogenous decomposition of peroxidic material formed in these products. This two-stage phenomenon is identical with that occurring in media *spontaneously* ignited at suitable temperatures and pressures², the essential difference being that with artificial ignition in cold media, the limiting pressures are much higher.

'Figure of Merit' of X-Ray Tubes

At the Leeds meeting of the X-Ray Analysis Group of the Institute of Physics¹ I gave certain figures for the comparative speeds of photographs using a Philips tube, a Shearer gas-tube and the 5 kW. filament tube at the Davy Faraday Laboratory.

In justice to the commercial tube makers, I ought to make it clear, as I hoped I had made it clear at the meeting, that the Philips tube I had used for purposes of comparison (the only one available to me at the time) was already eleven years old and had, in fact, since 'died'. The Shearer tube was just as old, but demountable tubes never die, they only fade away, when it becomes desirable to replace them

¹ Mitra, *Ind. J. Agric. Sci.*, 6, 555 (1936).

² Mukherjee Mitra and Mukherjee, *Trans. Nat. Inst. Sci. Ind.*, 1, No. 10, 227 (1937).

³ Mukherjee and Mitra, *Ind. J. Agric. Sci.*, 12, 433 (1942).

⁴ Wiegner and Pallmann, *Ver. Zuei. Komm. Alkali-subcomm. Internat. Bod. Ges.*, B, 92 (1929).

⁵ Unpublished work of S. N. Bagchi.

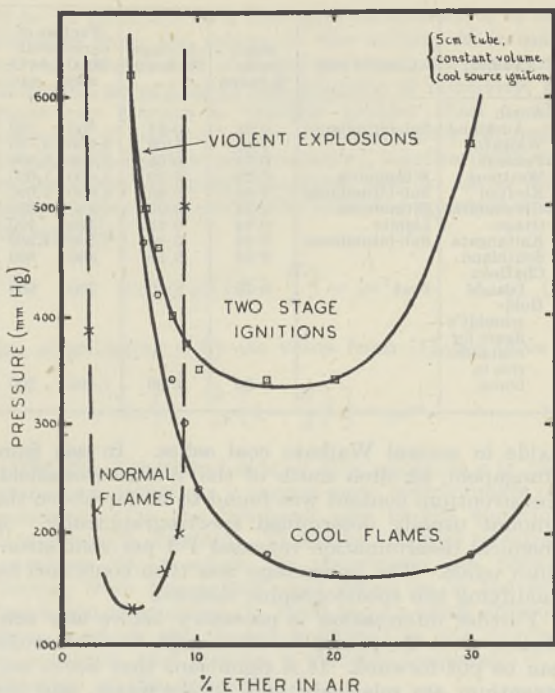
⁶ Sanders, *Ind. Eng. Chem., Anal. Ed.*, 10, 274 (1938).

⁷ Mukherjee and Sen Gupta, *Nature*, 145, 971 (1940).

⁸ Mukherjee, *Kolloid Z.*, 62, 257 (1933).

⁹ Mitra, Mukherjee, S., and Bagchi, *Ind. J. Agric. Sci.*, 10, 303 (1940).

¹⁰ Mukherjee, Mitra, Chatterjee and Mukherjee, S., *Ind. J. Agric. Sci.*, 12, 86 (1942).



Hitherto it has not been possible with cold media to identify the cool-flame range within the normal flame range, for attempted ignition of cool flames by the means stated has invariably given rise to normal flames. An advance in this field has recently been made in that it is now possible completely to establish the cool-flame system (see graph); this was achieved in the first instance by allowing a cool flame initiated in a combustible-rich mixture located in one section of a 1.5 cm. tube to pass into a mixture of composition within the normal flame range located in another section, connexion being effected by means of a uniform-bore tap. Similar observations have also been made with higher hydrocarbons and other suitable combustibles; and later the procedure became simplified when it was found possible successfully to employ a specially designed igniting source at rigidly controlled temperature. The importance of these observations may be appreciated by the statement that under suitable pressure conditions it is possible for a cool flame to travel quiescently through even a *theoretical* combustible air-oxygen mixture which, if subjected to a spark or other usual igniting source, would give rise to an explosion shattering the containing vessel. At higher pressures (Fig. 1) the two-stage ignition mechanism occurs, giving rise in such a mixture to an explosion of great violence and of the type enhanced by shock waves. Indeed, there is strong evidence that under the conditions arising in internal combustion engines this two-stage ignition mechanism is, in fact, that responsible for 'knock'.

These observations throw light on the kinetics of the processes concerned; they may also be of significance when considering possible sources of ignition of inflammable vapour-air media in industries where solvents are employed, or possibly in operating theatres in hospitals. For it is possible for a cool flame initiated by a low-temperature source in a rich mixture (for example, ether vapour near a floor) to pass unobserved for some distance until, on pass-

ing into a mixture of higher oxygen content (for example, ether vapour more remote from a floor), an explosion of violence might occur.

The investigations referred to form part of a larger programme assisted by the Department of Scientific and Industrial Research.

K. SPENCE.

D. T. A. TOWNEND.

Dept. of Coal Gas and Fuel Industries,
University, Leeds, 2.

Jan. 23.

¹ White, *J. Chem. Soc.*, 1462 (1919); 498 (1927). Townend and Chamberlain, *Proc. Roy. Soc., A*, 158, 415 (1936). Hsieh and Townend, *J. Chem. Soc.*, 337 and 341 (1939). Maccormac and Townend, *J. Chem. Soc.*, 143 and 151 (1940).

² For example, Townend, *Chem. Rev.*, 21, 259 (1937).

Particle Shape

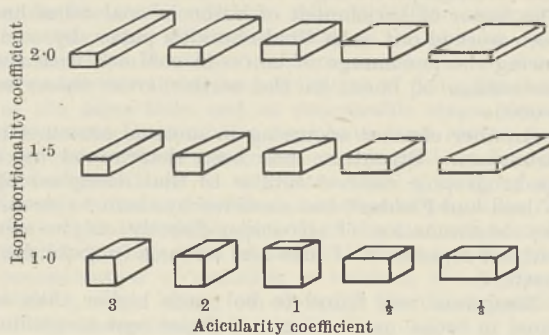
In the chemical literature it is customary for crystalline substances to be characterized as forming needles or plates. It is interesting to note that this concept of acicularity can be given a precise quantitative meaning and applied to any regular solid figure of which the three principal dimensions are known, and may be extended to cover the general form of irregular figures. In the present instance, rectangular solids are considered for the sake of simplicity, and the three dimensions denoted as a , b , c , where $a \geq b \geq c$.

Psychological tests have shown that a figure is instinctively considered to be acicular if $a:b$ is greater than $b:c$, and tabular if $a:b$ is less than $b:c$. If $a:b$ equals $b:c$, no decision can be obtained as to whether the body is to be considered acicular or tabular. This criterion, related as it is to ordinary experience, is therefore considered to be the most satisfactory to adopt, and we define a quantity called the 'acicularity coefficient' as

$$\text{acicularity coefficient} = a:b \div b:c.$$

Bodies thus have an acicularity coefficient greater than unity if needle-shaped, and less than unity if tabular.

In the accompanying diagram the acicularity coefficient is constant in any vertical column. Another parameter is therefore required in order to specify uniquely any given shape. This is provided by $a:b$ or $b:c$, whichever is the smaller. For this parameter we propose the name of 'isoproportionality coefficient', as it specifies the figure in the central column of the diagram which may be considered to be the parent figure of the corresponding horizontal row, just as the cube is the parent figure of the square prisms.



The correct method of applying these concepts statistically to a collection of particles is indicated as follows. If the particles have no inherent tendency to a needle- or plate-like form, it follows that those with an acicularity coefficient of n and $1/n$ will occur with the same frequency, and hence, for any one value of the isoproportionality coefficient, the sum of the values of $a : b$, and the sum of the values of $b : c$ will be equal; that is

$$\overline{a : b} \div \overline{b : c} = 1.$$

Any inherent tendency to needle- or plate-like form will modify this value accordingly, and we therefore define a quantity, the acicularity factor, as

$$\text{acicularity factor} = \overline{a : b} \div \overline{b : c},$$

which is equal to the acicularity coefficient of a mean particle averaged in the special way involved in this definition. This derivation is applicable severally to groups of particles having every possible value of the isoproportionality coefficient, and therefore is applicable to any group of particles whatever, providing it be sufficiently large.

For statistical use, the isoproportionality coefficient will similarly give place to the isoproportionality factor, defined as

$$\text{isoproportionality factor} = \overline{x : y},$$

where $x : y$ is the smaller of the two ratios $a : b$, $b : c$, for each individual particle.

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Stockport.
Dec. 14.

Coalfield	Class of coal	Maximum % boron	Average % boron	Factors of enrichment	
				Maxi-	Aver-
				age	age
North					
Auckland	Sub-bituminous	0.21	0.21	700	700
Waikato	"	1.51	1.09	5,000	3,600
Taranaki	"	0.73	0.58	2,400	1,900
Westport	Bituminous	0.29	0.29	1,000	1,000
Reefton	Sub-bituminous	0.86	0.86	3,000	3,000
Greymouth	Bituminous	0.15	0.07	500	250
Otago	Lignite	0.14	0.11	500	400
Kaitangata	Sub-bituminous	0.44	0.39	1,500	1,300
Southland	"	0.24	0.18	800	600
Chatham Islands	Peat	0.10	0.10	300	300
Gold-					
schmidt's					
figure for					
coalashes					
rich in					
boron		0.30	0.06	1,000	200

oxide in several Waikato coal ashes. In ash from Mangapehi, an area south of the Waikato coalfield, the strontium content was found to be far above the amount usually determined spectrographically. A chemical determination revealed 1.3 per cent strontium oxide. The percentage was then confirmed by modifying the spectrographic method.

Further information is necessary before any conclusion as to the reason for these high concentrations can be put forward. It is significant that boron and strontium are relatively high in sea-water, and the high content of both may be connected in some way with contact of the coal measures with the sea. It must also be noted that the coals high in these constituents occur in hot spring or volcanic areas.

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¹ Goldschmidt, V. M., *J. Chem. Soc.*, 655 (1937).

² Wilson, S. H., and Fieldes, M., *N.Z. J. Sci. and Tech.*, 24, 98 (1942).

Boron and Strontium in New Zealand Coal Ashes

ATTENTION has been directed by V. M. Goldschmidt¹ to the occurrence of minor elements in coal ashes. During the complete analysis of ash of Waikato coal examined in connexion with clinkering troubles, Mr. F. T. Seelye, chief chemist at the Dominion Laboratory, New Zealand, noted a high boron content. The Coal Survey Division then undertook an examination to determine the distribution of boron in New Zealand coal ashes. Boron was present in highest amount in Waikato coals, but was also present in smaller percentages in all New Zealand coals.

The accompanying table sets out the maximum and average percentages of boron in each coalfield. The factor of enrichment of boron in coal ashes has been worked out as in Goldschmidt's paper, by comparing the percentage of boron in coal ash with the percentage of boron in the earth's crust taken as 0.0003.

Another element occurring in unusual amounts is strontium. Strontium has been determined by a spectrographic method similar to that described by Wilson and Fieldes², but modified by them to permit the determination of strontium directly on the ash, without separation of lime and strontia (unpublished method).

Strontium was found to be much higher than is usual in rocks, amounting to 0.3 per cent strontium

Red Shift in the Anagalactic Nebulæ

A PHOTON $h\nu$ emitted by a distant nebula toward our galaxy possesses a mass

$$\mu = \frac{h\nu}{c^2} \dots \dots (1)$$

and the equation for its energy is

$$h\nu = \mu c^2 \dots \dots (2)$$

The mass μ of the photon is acted upon by the gravitational field of our galaxy, whatever this field may be: Newtonian, LeSagian¹, or the relativistic curvature of space caused by the mass of the galaxy.

The law of gravitation requires that any mass in the field of our galaxy must be accelerated toward it. Therefore, using the inverse square law for falling bodies, the energy of the photon from the nebula we observe should be

$$h\nu = \mu \left[\sqrt{c^2 + k \left(1 - \frac{R}{A}\right)} \right]^2 = \mu \left[c^2 + k \left(1 - \frac{R}{A}\right) \right], \dots (3)$$

where $k = \frac{2GM}{R}$, R is radius of our galaxy (assuming

it to be spherical as a first approximation), A is the distance from the galaxy to the nebula, M is mass of our galaxy, and G is the gravitational constant. However, according to the principle of relativity, no mass can acquire a velocity greater than c , the velocity of light *in vacuo*. Consequently, in order to preserve the law of gravitation, together with the conservation of energy involved, and to agree with the principle of relativity the following equation must be satisfied:

$$h\nu - \mu k \left(1 - \frac{R}{A}\right) = \mu c^2; \quad \dots \quad (4)$$

or, substituting μ by its value from (1), we have

$$h\nu \left[1 - \frac{k}{c^2} \left(1 - \frac{R}{A}\right)\right] = \mu c^2. \quad \dots \quad (5)$$

On the right-hand side of this equation c is constant and, therefore, μ cannot vary, which makes μc^2 constant. On the left-hand side of the equation, h is Planck's constant. Therefore, in order to satisfy equation (2), ν which we observe in the photon coming from the nebula, and which is on the left-hand side of equation (2), must have a value different from ν which the photon possessed at the moment of emission, and become a variable frequency ν^1 , a function of the argument A .

Equating (2) with (5), we have

$$h\nu^1 = h\nu \left[1 - \frac{k}{c^2} \left(1 - \frac{R}{A}\right)\right]. \quad \dots \quad (6)$$

This equation shows that under an acceleration by the field of gravitation a photon keeps its velocity constant by adjusting its frequency so as to compensate for the variation due to the acceleration.

The red shift of the 'expanding universe' is an immediate corollary of equation (6), as the observed wave-length λ^1 is $1/\nu^1$, and, therefore, increases with the distance A .

It seems that the idea presented is worth discussion; I should be much interested in any comments on the subject.

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Extension Division,
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Washington, 6, D.C.
Nov. 14.

¹ Abbott, C. G., "The Newtonian Lucretius", *Smithsonian Misc Collections*, 142 (1899). Shneiderov, A. J., "The Exponential Law of Gravitation and Its Effects on Seismological and Tectonic Phenomena", *Trans. Amer. Geoph. Union*, 61 (1943).

Surface Tension of Solutions

In a recent paper¹, Wales discusses the approximate relations for the surface tension of regular solutions. He concludes that the surface tension is linearly or quadratically related for ideal and regular solutions respectively to the molar volume fractions of the components.

Two facts, however, limit the applicability of these relations. (1) The omission to take into account the adsorption at the surface which is responsible for the disagreement between the relations obtained and the Gibbs equation for the surface tension. (2) The neglect of the orientation of molecules at the surface.

In a theory I have recently developed² both those effects are accounted for in terms of the monolayer, while the derived relations for the surface tension agree perfectly with the Gibbs equation and cover the whole range of concentrations. At close values of the surface tension, relations analogous to those derived by Wells are obtained, while the surface tension for ideal solutions is linearly related to the surface molar fraction, which indicates the area occupied by molecules of the given species in the monolayer. An inspection of the benzene-carbon disulphide system, discussed by Wells, shows the carbon disulphide molecule to be oriented perpendicular to the surface.

A paper devoted to the statistical treatment of regular solutions and, in particular, to the analysis of the benzene-carbon disulphide system was ready in February 1944 and is to appear shortly in *Acta Physicochimica USSR*.

A. A. SCHUCHOWITZKY.

¹ *J. Chem. Phys.*, 12, 134 (1944).

² *Acta Physicochim. USSR*, 19, 176 (1944).

Plant-Growth Substances and *Penicillium notatum*

It was considered of interest to study the effect of plant-growth substances on the production of penicillin by the mould *P. notatum*. Several experiments have been carried out using indole-3-acetic acid and α -naphthalene acetic acid. The study has included the use of various media with the Squibb strain of *P. notatum* (American Type Culture Collection). Heavy spore inocula were added to two quart bottles (flat type) containing about 300 ml. of the medium. The bottles after inoculation were kept at 23-24°C. and 80 per cent humidity. As might be expected, marked stimulatory effects of the growth-substances were found only in the cases of the simple media, such as Czapek-Dox with added brown sugar. The experiments reported refer to penicillin production in the latter medium with 4 per cent brown sugar. Addition of either of these growth-substances at the concentration of 1 part in 30,000 had no effect in a mineral and corn-steep (6 per cent) medium. The titres obtained with the simple medium plus the growth substances are higher than have previously been reported for this medium alone. The practical value of the findings is limited, however, for much higher titres are the rule with the corn-steep media. This work suggests that a part of the good results got with the corn-steep may be ascribed to its containing plant-growth stimulants; but this point has not been checked.

The results of repeated tests have been somewhat erratic because of the variation in bottles inoculated under identical conditions. Almost without exception, however, the bottles containing the growth substances have developed mature mould mats in somewhat shorter times, and the titres of penicillin (both at the same time and at comparable stages during the development of the mat) have been higher than in controls. It is not known whether this is due to a faster growth or to a greater total growth of the mould, or to an increased secretion of penicillin. It is thought that faster growth of the mat will account for the findings, for, of course, the quicker the peak concentration of penicillin is reached, the higher it will be, there being less time for the decomposition of the accumulating penicillin.

A single, complete experiment is given in the table, the titres representing the best bottle of a triplicate group. Repeated experiments gave the same indications, but not usually the same figures.

EFFECT OF PLANT-GROWTH SUBSTANCES ON PENICILLIN TITRES FROM *P. notatum* ON A SIMPLE MEDIUM.

Medium	Days after inoculation	Penicillin (Florey units per ml.)
Control	6	30
Indole acetic acid, 1 in 10,000	6	50
Naphthalene acetic acid, 1 in 10,000	6	25
Control	7	35
Indole acetic acid, 1 in 10,000	7	50
" " " 1 in 100,000	7	35
Naphthalene acetic acid, 1 in 10,000	7	40
" " " 1 in 100,000	7	50
Control	11	28
Indole acetic acid, 1 in 10,000	11	50
" " " 1 in 100,000	11	30
Naphthalene acetic acid, 1 in 10,000	11	30
" " " 1 in 100,000	11	45

It is thus seen that indole acetic acid at a concentration of 1 part in 10,000 gives the quickest high titre of penicillin, whereas it is not so active at 1 to 100,000. Naphthalene acetic acid is more active at 1 part in 100,000, giving a titre peak in seven days. The two concentrations mentioned were the only ones studied, and it is likely that the optimal one has not been chosen. Work along these lines is being continued.

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Ripening of the Onion Bulb and Infection by *Botrytis* Species

THE first sign of normal ripening in the onion plant, it is supposed, consists of a local collapse at the neck, resulting in the leaf blades falling over on to the ground while several of them are still green and turgid; this can occur with plentiful soil moisture^{1,2}, though hastened by drought, and has been attributed (*loc. cit.*) to a softening of the tissues of the neck. The true explanation would appear, however, to be purely mechanical, and connected with the mode of development of the onion bulb. In the absence of bulbing, as in an onion plant growing in short days, new leaves emerge at regular intervals. Each leaf consists of a thin-walled hollow cylindrical leaf base surmounted by a more or less cylindrical 'blade' which is at first solid but later develops a lysigenous cavity. At the junction of the leaf base with the leaf blade a pore is found, through which the next younger leaf emerges. The neck of the actively growing onion plant thus consists of a number of very thin concentric leaf bases enclosing a practically solid core of growing leaf blades. The outermost leaf bases are dead and papery, but even the living ones have little inherent rigidity; the solid core is formed by the blade or blades of the one or two leaves next emerging. When, under the stimulus of long days, bulb development occurs, leaf emergence ceases immediately or soon according

to conditions^{2,3} and the three leaf initials next due for emergence become instead swollen bulb scales with practically no leaf blade³. The result is that after the blade of the last leaf has emerged there are no more to provide the solid core of the neck, which thus becomes a thin-walled hollow tube. This soon buckles and collapses under the weight of the green leaf blades, especially in wind or drought. Experiment has shown that removal of the central core very greatly reduces the resistance of the neck to buckling.

The common horticultural practice of bending onion plants over at the neck to hasten ripening thus appears groundless. If bulbing has not proceeded far enough to stop leaf emergence, the practice can only result in breaking or bruising the next emerging leaf blade, while if leaf emergence has ceased the neck will of itself collapse very soon, though there seems no obvious reason why this should either hasten the drying of the leaf blades or the onset of dormancy, which together accompany ripening.

Before bulbing occurs, the pore at the junction of leaf base and blade is from the earliest developmental stages of the leaf initial blocked by the tip of the subsequent leaf². The last leaf to emerge after bulb development, however, has an open pore, since the next leaf initial forms a swollen bulb scale the blade of which fails to elongate. If, therefore, this last leaf emerges fully before collapse of the neck occurs, the onion plant has then a more or less open pore communicating directly by the hollow neck with the interior of the bulb. Since we have in a number of cases found the swollen bulb scales infected (apparently with *Botrytis* spp.) while the surrounding swollen leaf bases³ have appeared healthy, it would seem that this probably provides one of the modes of infection of the onion bulb by spores of *Botrytis* spp., which constitutes one of the main problems of economic importance connected with onion culture and storage in Great Britain. Another likely path of infection is via the pores of the other (older) leaves, since these sag open as the leaves wither and thus provide pockets for the lodgment of air-borne spores and probably fairly high humidities for their germination. This would presumably lead in the first instance to infection of the swollen leaf bases rather than of the swollen bulb scales, and this is the most frequently observed condition in the early stages of *Botrytis* 'neck rot'. That infection does in fact occur via these pores is indicated by our observations of the occurrence of 'neck rot' in the greenhouse, where the plants are somewhat etiolated and the necks very much longer than under field conditions. Here the tissues of the leaf bases are killed high up on the neck near the pores, and even the whole neck rotted through at that level, before the bulb shows any obvious infection.

The above considerations provide yet another example of the importance of the cessation of leaf emergence with bulb development in accounting for the behaviour of the onion plant².

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¹ Heath, O. V. S., *Ann. Appl. Biol.*, **30**, 208 (1943).

² Heath, O. V. S., *Ann. Appl. Biol.*, **30**, 308 (1943).

³ Heath, O. V. S., and Mathur, P. B., *Ann. Appl. Biol.*, **31**, 173 (1944).

Sulphonamides and American Foul Brood Disease of Bees

AN editorial note in a recent issue of *Gleanings in Bee Culture* (72, 493; 1944) reports on the use of sulphathiazole in the treatment of American foul brood disease of bees by Prof. Haseman, University of Missouri, Columbia. Sugar syrup containing sulphathiazole fed to the bees enabled them to raise healthy brood in combs containing the scales of larvæ which had died of the disease.

In 1943, Mr. C. A. Ekins, of Brookwood Hospital, Surrey, sent to this Department an account of some experiments he had been carrying out since May of that year, in which sulphapyridine was being used in the treatment of five colonies of bees affected with American foul brood. He continued his experiments until July 1943 (with further treatment as a preventative measure in the following spring), since which date, he reports, there has been no recurrence of the disease. No evidence of disease was found when the colonies were examined in May 1944 by the local officer appointed for the inspection of apiaries under the Foul Brood Disease of Bees Order.

Following upon Mr. Ekins' claims of complete success with his treatment, and after consultation with him, it was decided to carry out a trial of sulphapyridine in the experimental disease apiary at Rothamsted. Accordingly, in June 1944, two colonies of bees of approximately equal strength, and headed by hybrid queens of the same age, were infected with American foul brood by feeding them a suspension of the spores of *Bacillus larvæ* in sugar syrup. The disease was allowed to run its course in both colonies until August 3, when one of them was fed 600 ml. of sugar syrup containing 3 gm. of soluble sulphapyridine. This treatment was repeated at weekly intervals, four doses being given in all. The other colony was fed plain syrup in equal quantities on the same dates. On September 8 the bees in both colonies were killed and the combs then examined. No major honey flow occurred during the period of treatment.

There was a marked difference between the two sets of combs. In those from the treated colony all the recent brood appeared healthy, though somewhat scattered and irregular in arrangement. No larvæ in the early or ropy stage of the disease were found, with the exception of two individuals situated on a comb remote from the three combs forming the actual brood-nest. Scales, the formation of which normally takes about three weeks from the death of the larva, were, however, present in eight out of the eleven combs in the hive. In the combs from the untreated colony many ropy larvæ were present, along with others showing the progressive stages leading to the formation of the scale.

It would appear, therefore, that during the course of the treatment the progress of the disease within the colony had been arrested, and that only healthy brood was being reared in combs where the disease had previously been established. The test was a severe one owing to the length of time which elapsed between infection and the beginning of the treatment; it was purposely not carried to its ultimate conclusion because of the lateness of the season and because of the danger of robbing by bees from other hives nearby.

It should be noted that the conditions of the experiment were not identical with those of the ex-

periments carried out by Mr. Ekins, who combined manipulative methods with the sulphapyridine treatment, and a complete elimination of the disease, as claimed by Mr. Ekins with his methods, was not obtained. The result does, however, justify the planning of future tests on a larger scale.

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Phagocytosis and Storage of Trypan Blue in the Appendix of the Rabbit

THE observations of Baker and Enticknap¹ substantiate the claim of Bizzozero and Ruffer (cited by McEwan²) that an active phagocytosis occurs in the appendix of the rabbit, the agents concerned being large mononuclear cells present in the lymph follicles and lymph papillæ of the submucosa. The following observations made on the appendices of vitally stained adult rabbits throw additional light on this process.

The dye, trypan blue, was administered subcutaneously in a 2 per cent solution in distilled water and the animals were killed at various intervals after stopping the injection. The amounts of the dye used, the frequency of the injections and the times when the animals were killed are given in the accompanying table.

Rabbit	Daily dose of trypan blue (c.c.)	No. of injections	Time between last injection and killing
1	2.5	1	12 hr.
2	2.5	2	2 days
3	2.5	2	10 days
4	5.0	2	2 days
5	5.0	2	10 days
6	7.0	2	2 days
7	7.0	2	5 days
8	10.0	2	2 days
9	10.0	2	10 days

Following the administration of trypan blue in moderate concentration (R 1, R 2 and R 3) particulate segregation of dye particles occurred in the cytoplasm of cells in the serous coat, in reticulum cells surrounding the follicles and in certain cells of the mucosa. The dye-containing cells in the serosal coat were frankly macrophagic. Those in the peri-follicular tissue were rather smaller, but the majority of them exhibited the staining characters of macrophages. A few showed an early rosette arrangement of the dye particles often seen in monocytes. These cells were abundant in the region of the peripheral lymph sinus of the follicles, and at many sites appeared to project into its lumen. Cells of similar size and with identical staining characters occurred near the lymph channels in the mucosa. At other situations in this zone, notably around encysted sporozoa (abundant in larger or smaller groups), macrophages with a more bulky cytoplasm were electively stained, and the appearances suggested that many of them play an important part in the defence reaction of the mucosal tissues towards these parasites. The follicular lymphocytes were not affected by the dye; but numerous large moribund cells and disintegrating cell debris in the centre, and to a less extent at the periphery of the follicles, were diffusely stained (see photo.).

The administration of the dye in larger amounts (R 4, R 5, R 6 and R 7) produced a marked increase in the number of dye-containing cells in the peri-follicular zone and around the mucosal lymph



LONGITUDINAL SECTION OF RABBIT APPENDIX (R.5) SHOWING DIFFUSELY STAINED MORIBUND CELLS IN THE CENTRAL AND PERIPHERAL REGIONS OF A LYMPH PAPILLA. MASSON'S PONCEAU-ACID FUCHSIN, $\times 120$.

1, Epithelium of papilla; 2, reticulum in deeper part of mucosa containing lymph channels and blood vessels; 3, mucosal lining; 4, lumen of appendix.

channels. In R 5 and R 7, the animals of this series which were killed at later periods, there was, as compared with R 4 and R 6, an appreciable reduction in the number of the stained cells associated with the lymph channels in the perifollicular and mucosal regions. This reduction appeared to be due to a desquamation or migration of the cells into the lymph follicles, where the appearances indicated that some were phagocytosed among the central cells of this region. R 5 and R 7 also exhibited fine dye inclusions in the cytoplasmic processes of the perifollicular reticulum fibres, and in many situations dye particles were observed in elongated cells lying adjacent to the endothelium of the blood vessels. In all animals of this series the intensity of the stained elements around encysted sporozoa deepened.

In more intensely stained animals (R 8 and R 9), cells of macrophagic character containing fine dye particles appeared in increasing numbers within the lymph follicles. Many of these cells had presumably migrated into this situation from extrafollicular sites, but there was evidence in R 9 that dye particles had been segregated by certain follicular cells—possibly lymphocytes which had developed in a macrophagic direction as a defence reaction to the increased stimulation.

It was noted that the central parts of most of the lymph follicles contained many large mononuclear cells having all the morphological characters of macrophages but which were entirely unaffected by the dye. These cells are probably identical with the phagocytic elements (macrophages) recorded by Baker and Enticknap¹. It may be that the relatively poor blood supply to the regions containing these cells accounts in part for their inability to segregate dye particles. On the other hand, it is possible that other activities peculiar to their situation, for example, phagocytic, incapacitate them from taking up other substances presented to them, as Cappell² has suggested in the case of similar cells found in lymph glands.

The above observations confirm the presence of numerous phagocytic cells within the lymph follicles of the rabbit appendix, but the majority of these are not readily stainable by means of trypan blue administered by the subcutaneous route. A renewal of

the elements concerned in this process from follicular cells is indicated, and the proximity of diffusely stained moribund cells and of extracellular dye particles to the epithelium covering the lymph papillae suggests a process of elimination at this site. It would appear that phagocytosis occurs mainly within the follicles. In this situation a true germinal or lymphoblastic core is not well established, and Crabb and Kelsal¹, following the suggestion of Ehrlich⁵, refer to this tissue as "lymphoid" rather than lymphatic. Latta⁶ and West⁷ regard the central part of the follicle as a region of cellular degeneration rather than one of proliferation. Latta⁶ recorded a decrease in the number of lymphocytes and the presence of numerous moribund cells in the central parts of the follicles, and stated that this results from a local inanition due to the poor blood supply of these regions. Crabb and Kelsal⁴ observed "clusters of moribund large lymphocytes resembling the 'ghost cells' of Todd and Sanford"⁸ towards the periphery as well as in the central parts of the follicles, and recognized the possibility of the former site as being closely related to elimination.

While the levels of vital staining employed in the above experiments produced no obvious general upset in the animals, it is important that care should be exercised in the interpretation of results, for in this, as in other situations, the dye itself is obviously capable of producing proliferative changes in susceptible elements.

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¹ Baker, F., and Enticknap, J., *Nature*, 151, 532 (1943).

² McEwan, R., *Brit. Med. J.*, ii, 873 (Oct. 1904).

³ Cappell, D. F., *J. Path. and Bact.*, 32, 595 (1929).

⁴ Crabb, E. D., and Kelsal, M. A., *J. Morph.*, 87, 351 (1940).

⁵ Ehrlich, W., *Amer. J. Anat.*, 43, 347 (1929).

⁶ Latta, J. S., *Amer. J. Anat.*, 29, 159 (1921).

⁷ West, L. S., *Anat. Rec.*, 28, 349 (1924).

⁸ Todd, J. C., and Sanford, A. H., "Clinical Diagnosis by Laboratory Methods" (Philadelphia: W. B. Saunders Co.).

Colour-blindness in Left Eye following an Accident

A MAN of fifty years of age, knocked down by a bus in 1942, sustained fractures of facial bones on the left side, was unconscious for ten days, saw double for six months, had electrical treatment and recovered. There were no brain injuries, but severe facial paralysis on the left side. In 1944 he was brought by a friend, Mr. W. Macaulay, and proved an accurate and consistent observer. The left eye was his better eye before the accident.

Prof. Arnold Lowenstein kindly examined his eyes, with the following results: R. fissure 12 mm., L. 10 mm.; L. eyelids unable to close completely; no disturbance of eye-movements; L. cornea hypoesensitive; R. pupil 4 mm., L. 3.5 mm., both pupils gave immediate reaction to light, but L. reaction inconsiderable; convergence reaction to 2.5 mm. in both pupils. R. eye: fundus myopicus with inferior conus and optic coloboma between 5 and 7 o'clock; disk of pinkish colour. L. eye: 1-1.5 d. myopia; disk sharply defined, of a bluish-white colour; vessels well filled and no sheathing; atrophic excavation, small area of pigmentation round disk; otherwise fundus normal.

Usual colour names		Violet	Blue	Blue-green	Green	Yellow-green	Yellow	Orange	Red
Names used by subject	R. eye	Light blue	Blue	Blue-green	Green	Yellow	Yellow	R. yellow	Red
	L. eye	Grey	Grey		Green		Grey	Grey	Grey

Visual acuity was corrected as follows, without correcting astigmatism: R. eye to 4/36 with -4.0 d.; L. eye to 4/18 with -1.0 d. With these corrections he did the Ishihara test (25 plates): R. eye, all correct; L. eye, none legible whatever.

Perimeter test: R. eye normal with 1 cm. disks of red, yellow, green and blue. L. eye normal with 5 cm. disks of red, yellow and blue, but 1 cm. disk of green sufficed. No central scotoma, but red was less saturated in central area, L. eye.

Independently of Prof. Lowenstein, a colorimeter test showed that the right eye was normal but had a slight weakness in red, but the left eye was normal only for green, since red, yellow and blue were equated with greys of normally equivalent brightness.

After six to seven weeks, when the other tests were done, the right eye gave the same result, but the left eye had improved to about 1/25 normal thresholds for red, yellow and blue. This corresponded to the perimeter test, in which the left eye had 1/25 normal sensitivity to these colours.

The Edridge-Green Beads and the Holmgren Wools confirmed that colour vision was normal with the right eye, while green was the only colour seen clearly with the left eye. The colour perception spectrometer gave the result shown in the accompanying table.

The subject knew that he could see only green clearly with the left eye, and identified it as the colour he called green with the right eye.

The bearing of this case on theories of colour vision is important. It would be expected that primary colours, on any theory, might be lost independently of each other through shock or injury, and/or that colours lower in the scale of evolution, on any theory, would be retained longer after injury or shock, while those more recently evolved would recover last.

*Willmer's 2-colour theory*¹. Red and violet are the only primaries. Loss of these would give total blindness; partial loss would give darkening of both ends of spectrum and proportional loss of green. The theory is not supported.

Young-Helmholtz 3-colour theory. Green might be retained while red and violet-blue were lost, but both ends of spectrum would be extremely darkened.

*Walls's modified 3-colour theory*². Weakness of colour vision is due to shifting of sensitivity curves so that they overlap. Red and blue-violet might be lost, but both ends of spectrum would be darkened, and, since all three sensitivity curves would now overlap in the middle, 'green' would be greatly brightened and would be wholly replaced by grey. No support is given to either form of the Helmholtz theory.

Ladd-Franklin's evolutionary theory. If yellow and blue are lost, then both red and green must be lost, too, since they evolved later and depend on the integrity of the blue and yellow sensations.

Edridge-Green's theory. The dichromic form of colour vision discriminates the ends of the spectrum as yellow and blue, and evolves out of monochromic vision, in which only grey is seen. It develops into trichromic colour vision, in which green is added between yellow and blue. In the case reported green

is distinguished from the ends of the spectrum, which are both grey, and it lends no support to the theory.

Hering's 4-colour theory. Blue and yellow, and/or red and green, could be lost while the corresponding brightness sensations remained. Green could be retained, as in the case reported, while red, yellow and blue were lost, if the dissimilative process of the red-green pair became checked at the neutral point and could not proceed towards red.

*Houstoun's modification of Hering's theory*³. The changes from red to green and from yellow to blue depend on the proportions of red to green and of yellow to blue responses. Yellow and blue light might both excite yellow and blue responses equally frequently, giving yellow-blue blindness. Green light might still excite the normal preponderance of green over red responses, and red light excite both red and green responses equally often, so that the normal change over failed to proceed further than the neutral point. This would explain the case described.

In general, it may be concluded that the case described strongly negates all colour theories except Hering's, while Houstoun's modification of this theory is the most fully supported.

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¹ *Nature*, 151, 213, 632 (1943); 152, 190 (1943).

² Walls, G. L., "The Vertebrate Eye", 83ff. (1942).

³ Houstoun, R. A., "Vision and Colour Vision", ch. 14 (1932).

Cannibalism in *Aurelia*

PLANULÆ of *Aurelia* were washed out of the brooding pits of the mother medusa and allowed to settle down in small dishes about 35 mm. wide and about 7 mm. high (very suitable for microscopic investigation). These dishes were gently placed in large basins (capacity about two litres) and left undisturbed until the larvæ got hold of their substratum. This usually took about 36 hours, after which time the basins were placed under running sea water, thus giving the larvæ access to their natural food. However, it was observed that certain scyphistomæ attacked their neighbours. The 'aggressor' would extend its body until the mouth would reach the 'victim'; then the mouth would be widened so as to enclose the greater part of the victim, which would resist and stick firmly to the substratum. A struggle would take place, but at last the whole body of the victim would be taken in the coelenteron of the aggressor. The scyphistomæ usually bud off a number of individuals which separate and settle down round the mother-scyphistoma, but cannibalism has not been observed among members of such a group.

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RESEARCH ITEMS

Secondary Sexual Characters in Beetles

THE great development of horn-like outgrowths in male Dynastid beetles is a conspicuous secondary sexual character. What these horns are used for has long attracted attention and excited speculation. William Beebe (*Zoologica*, 29, Aug. 1944) records observations made in the New York Zoological Society's Laboratory at Caripito, Venezuela, on the elephant beetles *Megasoma elephas* and *Strategus aloeus*. In both these species he finds that the males use their cephalic and thoracic horns for fighting with each other. The initial stimulus appears to be the advent of the rainy season. The technique of fighting seems to be the same for both species: first an effort to unbalance the opponent by tripping, and then by ventral attack with the anterior horn so as to throw him on his back. It is interesting to note that Charles Darwin, in the first edition of "The Descent of Man", claimed that the most obvious conjecture is that these horns are used by the males for fighting together. But since they had never been observed to fight, he came to the conclusion that they were acquired as ornaments. Eight years afterwards, A. R. Wallace, in "Tropical Nature", expressed the view that these horns may be protective. Their presence, he says, would render it very difficult for the large-mouthed goatsuckers and other nocturnal birds to swallow the beetles. It is therefore noteworthy that Mr. Beebe's observations appear to settle this disputed point, and are supported by a very convincing series of successive photographs taken of actual combats.

Intracellular Symbiosis and Vitamin Requirements of Insects

MANY insects contain symbiotic micro-organisms, usually bacteria or yeasts. The organisms are intracellular and are housed in special organs called mycetoms. One function of such organisms seems to be the synthesis of certain vitamins normally required for the nutrition of the insect. M. Blewett and G. Fraenkel (*Proc. Roy. Soc.*, B, 132, 212; 1944) have studied this question in the case of the larvæ of two beetles, *Lasioderma serricorne* and *Sitodrepa panicea*. It is possible to sterilize the eggs before hatching and so obtain larvæ free from symbionts (sterile larvæ). Such sterile larvæ fail to grow if the diet is deficient in any one of the following components of the vitamin B complex: thiamin, riboflavin, nicotinic acid, pyridoxin, pantothenic acid. On a diet rich in vitamin B (wholemeal flour and yeast) both sterile and normal larvæ grew equally well; while on a diet deficient in vitamin B (white flour) the sterile larvæ did not grow so well as the normal ones. It was concluded that, in the case of these two larvæ, the normal symbionts could synthesize the various components of the vitamin B complex in amounts sufficient to meet the normal growth requirements of the larva (see also *Nature*, 152, 506; 1943).

Nervous Control of Intestinal Function in the Earthworm

N. MILLOTT (*Proc. Roy. Soc.*, B, 131, 271; 1943) has shown that the intestine of *Lumbricus*, while possessing an intrinsic nervous system of its own, is also supplied by nerves from the central nervous system. There are two such extrinsic systems of nerves, one inhibitory and one excitatory to the intestinal muscle, and the condition is thus parallel to that obtaining in the vertebrates. Further (*Proc.*

Roy. Soc., B, 132, 200; 1944), Millott has shown that stimulation of the extrinsic nerve supply causes the secretion of protease by the glandular cells of the intestinal epithelium. The glandular cells showed the usual histological changes associated with secretion, and an increase of protease was demonstrated in the intestinal fluid. The probable course of the nerve fibres was mapped out by the usual methods of electrical exploration.

Rubidium in Algae and Freshwater Plants

THE presence of rubidium as a 'trace element' in certain plants has been recognized since 1862, when Grandea identified it in the ash of beet and succeeded in extracting no less than 400 gm. of pure rubidium chloride from that source. Rubidium has also been reported in various other plants and plant organs (for example, tobacco leaves) and is usually derived by the plant from traces present in the soil. T. F. Borovick-Romanova, in a paper on the content of rubidium in plants (*C.R. Acad. Sci. U.S.S.R.*, 43, 163; 1944), gives an account of the quantitative spectroscopic examination of the ash from fifteen different seaweeds (*Laminariales*, *Fucales*, *Rhodomyeniales* and *Charales*) and from fourteen higher water-plants. The results, which are tabulated to show the percentage of metal in the ash and in the live plant, and also the rubidium-potassium ratio, were checked by comparison with lines produced by addition of definite quantities of barium salts. The rubidium content of the seaweeds is more than ten times that of the sea water in which they grew (2×10^{-6} per cent), while in the freshwater plants it is almost a thousand times that of the medium in which they were found. The rubidium-potassium ratio is higher in the *Laminariales* than in the *Fucales*, the average rubidium content being about 1 per cent of the ash, or 0.005 per cent of the live weight. Among the freshwater plants examined, the water-lilies showed the highest rubidium content, with 6.7 per cent of the total ash from the roots of *Nuphar luteum* (or 0.0052 per cent of the fresh weight). The plants had been collected between 1933 and 1938 from such widely separated parts as the Barents Sea, the Pacific Ocean, the Caspian Sea and the Staroselje reserve of the Ukrainian Academy. Their examination occupied the intervening years and follows a study of the distribution of rubidium in sea waters. It is a part of a survey of the occurrence of rubidium in the biosphere.

Boron in Horticulture

SINCE the first demonstration that boron is an essential element in plant nutrition, boron deficiency in a great variety of crop plants growing in the field has been recorded. Correction of boron deficiency by the use of dressings of borax is not always a straightforward matter, as in many cases the limits of boron tolerance are narrow, and A. S. Heinicke, W. Reuther and S. C. Cain (*Proc. Amer. Soc. Hort. Sci.*, 40, 31; 1942) suggest that the application of borax even to a boron-deficient soil may induce separation of apple fruits from the trees, although this may be the result of an acceleration of fruit development as found by L. P. Batjer and M. H. Haller (*ibid.*, 40, 29; 1942). Usual dressings of borax are of the order of 10 lb. per acre; this amount is sufficient to control boron deficiency in the field in cauliflower, radish, beet and swede (R. H. White-Stevens, *ibid.*, 39, 367; 1941), while half this amount will increase the yield of potatoes and peas on

soils deficient in boron, but where the deficiency is not sufficiently acute for characteristic boron deficiency symptoms to develop. Twenty pounds of borax per acre may be harmful to spinach and carrots; and it is therefore surprising to find that indications of borax injury to eighteen-year-old apple trees did not develop until the applications of borax to the soil had reached the level of 10 lb. per tree (L. P. Latimer and A. P. Percival, *ibid.*, 43, 21; 1943), and these damaged trees showed complete recovery in the following year.

Spraying of Fruit Trees with Growth Substances

A. E. Hitchcock and P. W. Zimmerman (*Proc. Amer. Soc. Hort. Sci.*, 42, 141; 1943) describe the effects of spraying different fruit trees during the summer with growth substance (potassium α -naphthyl acetate). Peach and plum especially and apple, pear and cherry, to a lesser extent, responded to the treatment by delaying the opening of fruit and flower buds in the following spring. In the same journal, P. C. Marth (pp. 620-628) describes how exposure of rose bushes during the winter to the vapour of naphthyl methyl acetate retards their shoot development. The magnitude of the response depends partly on the physiological condition of the bushes—'high starch' plants showing a greater retardation of shoot growth than 'low starch' ones. Of theoretical interest, these experiments have a practical bearing also as they offer with rose and fruit bushes a possible method of prolonging shoot dormancy and so escaping some of the damaging effects of spring frosts, and of extending the planting season.

Verticillium Wilt of the Tomato

WILT diseases of the tomato crop are widespread, and though a useful control can be effected by maintaining the temperature between 70° and 74° F., this is not always feasible. Soil factors which affect the pathogenicity of the fungus *Verticillium albo-atrum* have been investigated by F. M. Roberts (*Ann. Appl. Biol.*, 30, 4, 327; 1943). Attack by the fungus appears to depend to some extent upon lack of competition from other soil organisms. Inoculation of the ground immediately after steam sterilization gave nearly 90 per cent infection, as against 55 per cent in unsterilized soil. Sterilization thirty-two days before inoculation resulted in only 28 per cent infection. Nitrogenous manures favoured infection; phosphate had little effect, but a deficiency of potash also encouraged the parasite.

Thermodynamic Diagrams of the Atmosphere

CARMELO DI CORLETO has discussed, under the title "Comparación Entre Los Diagramas Termodinámicos De La Atmosfera, Mas Usados En Meteorología" (*Pub. Fac. Cien. Fisicomat.*, 3, No. 1; Univ. Nac. De La Plata), the work of various investigators on the subject of variations in mass of moist air, due to ascending and descending movements. Diagrams based on the work of Hertz (1884), of Neuhoff (1900), and in more recent times of Kreitmeyer, Bjerknæs, Stüve, Shaw, Refsdal and Låijtman are supplied, and the basic assumptions regarding the various conditions, and the formula derived from these, are briefly discussed. There is a certain amount of discrepancy in the views of different meteorologists on the results of their investigations, to which the author directs attention at the end of the paper. Criticisms

of some of the diagrams are referred to, and the views of Brunt, Rothé and Refsdal on the diagrams devised by Neuhoff, Bjerknæs and Shaw are quoted. Comparison of the different diagrams, made in the paper, leads to the view that the preference for any thermodynamic diagram over another is based solely on questions of convenience. Any one of them provides the reader with the conditions of the air so far as atmospheric stability is concerned.

A New Representation of the Types of Nuclear Forces

IN *Revista de la Facultad de Ciencias Fisicomatemáticas*, 3, No. 29 (Institute de Física, La Plata, Argentina), Mario Bunge has a paper with the title, "Una Nueva Representación De Los Tipos De Fuerzas Nucleares". In Section 1 he deals with the fundamental characteristics of the usual representations of nuclear forces and gives a brief outline of the theories of Gamow, Gurney and Condon, Heisenberg and others. Operators are then introduced which are formally identical with those employed in Dirac's theory of the relativistic electron, and these are able to supply an explanation of the four quantum states of the nucleon in non-relativistic approximation. By the employment of this new notation, explicit use of the isotopic spin is excluded, and it is synthesized with the ordinary spin in a single four-valent variable. The various scalar and non-relativistic potentials theoretically possible are formed by means of these new operators, and they are then applied to the problem of the deuteron. At the end of the paper there is a discussion on the advantages and the limits of the representation.

Hydrogen Bond and Diamagnetism

A CRITICAL analysis of the available data by S. V. Anantkrishnan and P. S. Varadachari (*Proc. Indian Acad. Sci.*, 20 A, 128; 1944) shows that the contribution to diamagnetic property by the methylene group CH₂ is constant, $\chi_m = 11.69$. On this assumption, it is shown that hydrogen bonding leads to increased diamagnetism, with a susceptibility change of one unit per mol whenever structures of the type O—H . . . O=A are involved. A bifurcated hydrogen bond, as in iodic acid, apparently leads to an even larger value. The decrease of diamagnetism in water and alcohols on association is interpreted as due to an increase of the paramagnetic term associated with distortion. The interpretation of structures is considered in the paper.

Fatty Substances in Starch

CONSIDERABLE importance has been attached to the fatty constituents of starch, which interfere with the fractionation of starch and many properties of cereal starch pastes. Since the fat is not removed by a typical fat solvent such as ether or carbon tetrachloride, it has been supposed to be present in the form of esters with starch; but the adsorption of palmitic acid by starch is typical and throws doubt on this chemical theory. R. L. Whistler and G. E. Hilbert (*J. Amer. Chem. Soc.*, 66, 1721; 1944) find that the fat is easily removed from disintegrated corn starch granules by methanol, although it is difficult to extract from the intact granules. At the same time the phosphorus content of the starch is appreciably reduced, and the nitrogen content is affected to a lesser degree. All the fatty matter in corn starch (about 1 per cent) is apparently bound by associative forces rather than by primary valency bonds.

SOCIETY FOR GENERAL MICROBIOLOGY

THE inaugural meeting of the original members of the Society for General Microbiology took place on Friday, February 16, at the London School of Hygiene and Tropical Medicine, through the courtesy of the School authorities. Some two hundred members and friends of the new Society were present.

It may be recalled that the Society owed its formation to the preliminary work done by its organizing committee of some thirty members representative of the various disciplines of microbiology, which held its first meeting in London in the autumn of 1943 under the chairmanship of the late Sir John Ledingham. This Committee realized that the lack of contact between the various specializations in microbiology tended to impede the development of the science as a whole, and as the result of several informal meetings it came to the unanimous decision that the time was ripe to promote the advancement of microbiology by the formation of a society which would provide common meeting ground for those working in the various specialized fields. It was decided that the Society should concern itself with the study of bacteria, viruses, micro-fungi, protozoa and microscopic algae in their various biological activities, it being envisaged, however, that contributions to meetings would deal predominantly with the more fundamental aspects of the study of these forms, including their physiology, nutrition, chemotherapy, systematics and ecology. Subsequent meetings were held which were presided over in turn by Dr. Marjory Stephenson and Prof. A. A. Miles, and invitations to become original members of the proposed society were sent out by the secretaries, Dr. L. A. Allen and Dr. R. St. John-Brooks, on behalf of the Committee to a number of microbiologists representative of the various fields. This appeal met with a most encouraging response, and as some two hundred and fifty favourable replies were received, the Committee felt that they had ample grounds for proceeding with the inauguration of the proposed society.

Before the opening of the proceedings at the inaugural meeting, the secretaries read a letter which had been received from the president of the Royal Society, Sir Henry Dale, wishing the young Society every success.

Prof. Miles, as chairman of the Organizing Committee, briefly recalled the steps that had led to the movement to inaugurate the Society and asked the members if it was their wish that the Society should be inaugurated on the lines indicated in the proposed rules which had been circulated. The members present, having signified their unanimous assent by a show of hands, the chairman formally declared the Society for General Microbiology to be inaugurated. The office bearers who had been proposed by the Organizing Committee for the consideration of the members of the Society were then unanimously elected. They were as follows: *President*, Sir Alexander Fleming; *Secretaries*, Dr. L. A. Allen, Water Pollution Research Laboratory, Langley Road, Watford, Herts, and Dr. R. T. St. John-Brooks, Lister Institute, Elstree, Herts; *Treasurer*, Mr. H. J. Bunker; *Committee*, Dr. C. H. Andrewes, Prof. B. T. P. Barker, Prof. A. W. Downie, Dr. H. B. Hutchinson, Dr. B. C. J. G. Knight, Dr. A. T. R.

Mattick, Prof. A. A. Miles, Dr. Muriel Robertson, Dr. Kenneth M. Smith, Dr. A. W. Stableforth and Dr. Marjory Stephenson. The late Sir John Ledingham had also been nominated as a proposed member of the Committee, his untimely death creating a vacancy. Prof. Miles then asked the newly elected president to take the chair.

In the course of his presidential address, Sir Alexander Fleming said that the meeting had given birth to a new body corporate, which started with a membership approaching three hundred persons, including many of the leaders in the different branches of microbiology. The meetings which the new Society would hold would bring together workers in the various branches of microbiology who might not otherwise meet and who would thus get acquainted and talking together—it was in this way that real advances were made. Thus bacteriologists, perhaps medical, perhaps agricultural, perhaps industrial; mycologists, academic or industrial; protozoologists with various tastes; or biochemists with interests in all fields were now banded together in this new Society of Microbiology. They had grown up separately, and they had been so busy growing up that they never had time to meet and discuss their common problems until now. He stressed the fact that the new Society did not mean to compete with the existing societies, but had its special aim in the correlation of fundamental knowledge regarding the minute animals and plants which formed the basis of all our studies, rather than the application of the science to the many practical problems which were better dealt with by the older societies. There was ample room for all, and the fact that there had been such a general response to the invitation showed that the Society was going to fill a definite gap. The new Society had been born into a troublous world, and the shortage of paper—an essential metabolite!—would prevent it immediately embarking on the venture of a new journal. He thanked the members present for allowing him to preside over the Society's early infancy and he hoped to be spared to watch his successors lead the Society for General Microbiology along the straight path to honour.

The subsequent proceedings consisted of short addresses by selected speakers on various aspects of microbiology. Dr. F. M. L. Sheffield (Rothamsted Experimental Station, Harpenden) read a paper which had been prepared by her colleague, Mr. F. C. Bawden, who was absent from the country, on the importance of the study of viruses to microbiology; Prof. W. B. Brierley (Department of Agricultural Botany, University of Reading) spoke on problems of the micro-fungi, illustrated by reference to *Botrytis cinerea*; Dr. C. A. Hoare (Wellcome Research Institution) chose as his subject biological races in protozoa; Prof. R. H. Hopkins discussed the biology of yeasts; Dr. A. T. R. Mattick (National Institute for Research in Dairying, Reading) spoke on fundamental problems in dairy bacteriology; Dr. Marjory Stevenson (School of Biochemistry, University of Cambridge) took as her theme "Levels of Microbiological Investigation" and Dr. W. R. Wooldridge (London School of Hygiene and Tropical Medicine) read a paper dealing with the contribution of veterinary science to microbiological knowledge.

In concluding the business of the meeting, provisional rules were adopted and an annual subscription of one guinea was authorized—this amount to be adjusted later on when the journal of the Society came into being.

ABSORPTION, EXCRETION AND LOCAL APPLICATION OF PENICILLIN

THE well-known rapid absorption of penicillin when it is given subcutaneously or intramuscularly and its rapid disappearance from the blood and excretion by the kidneys was mentioned in an earlier article (*Nature*, 677, Nov. 25, 1944). J. H. Humphrey (*Nature*, 765, Dec. 16, 1944) concluded from a study of two cases of abortion with extreme oliguria that, when there is no significant renal excretion of penicillin, it is slowly inactivated in the body. Sir Alexander Fleming (*Lancet*, 620, Nov. 11, 1944) describes, with illustrations, the micro-methods which he has devised for the estimation of penicillin in the blood serum and other body fluids. In the same issue of the *Lancet* (p. 621) Sir Alexander Fleming, M. Y. Young, J. Suchet and A. J. E. Rowe record their work on the penicillin content of the blood serum after various doses have been given subcutaneously, intravenously and intramuscularly, either as single injections or by continuous drip.

The results confirm the fact that penicillin is rapidly absorbed after intravenous or intramuscular injection, disappears rapidly from the blood and is rapidly excreted in the urine. After three-hourly doses of 15,000 units, the amount of penicillin in the urine is such that it can be diluted 1,000 times or more and still inhibits the standard test *Staphylococcus*. The urine of one patient who had had four injections of 15,000 units at intervals of ten minutes contained at one time just after the last injection so much penicillin that it could be diluted 20,000 times before its bacteriostatic power disappeared. Penicillin appeared in the blood a few minutes after a subcutaneous or intramuscular injection, so that little is to be gained by intravenous administration. On the other hand, little time must be lost, because the rate of disappearance from the blood does not differ markedly after either intravenous or intramuscular administration. Measurable penicillin disappears from the blood "somewhat as follows" after it is given intramuscularly: 15,000 units in 2-3 hours, 20,000 units in 3 hours, 35,000 units in 4 hours, 50,000 units in 4-5 hours, 100,000 units in 5-6 hours. Thus continuous bacteriostatic power can be obtained in the blood much more economically by smaller doses such as 15,000 units than by larger doses such as 100,000 units. Six doses of 15,000 units every two hours (90,000 units) will maintain bacteriostatic powers in the blood for 12 hours, while a single dose of 100,000 units will maintain it for only 5-6 hours. It may not be possible, however, to give frequent injections, and sometimes a high concentration in the blood may be desirable for only a few hours; for example, during operations through septic tissues. The most economical hospital method of administration seems to be by continuous drip, intramuscular drip being in practice the best. Much more work is required to decide whether it is better to maintain a constant low level of penicillin in the blood or to have a very high level for a short time after the injection, followed by a period of very low level before the next injection. Clinically both systems have worked excellently.

Several methods of giving penicillin intramuscularly have been described. H. L. Milles (*Brit. Med. J.*, 118, Jan. 27, 1945) describes one such method of giving it over periods as long as four days. In the

same issue (p. 122), C. E. Last describes another method for continuous and accurate intra-muscular administration, and F. M. Berger (p. 116) describes a method of preparing penicillin for systemic administration, the product being, he found, effective, non-toxic and painless.

In the earlier note in *Nature* referred to above, the experimental attempt to keep penicillin in the body by giving *para*-amino-benzoic acid as well was mentioned. This substance apparently delays the passage of penicillin through the renal tubules. The *Lancet* (760, Dec. 9, 1944) notes another method of economizing it by incorporating it in an oily excipient designed to delay its absorption. Vegetable oils have been tried for this purpose, but have not been satisfactory. M. J. Romansky and G. E. Rittman (*Science*, 100, 196; 1944) have, however, had some success with mixtures of peanut oil and beeswax, which have been also used for prolonging the action of histamine and heparin. Dispersions of penicillin in this mixture retained their potency for 30-62 days either at 37° C., at room temperature or in a refrigerator. Injection of 5,000-10,000 penicillin units in 1 c.c. of this oily fluid into rabbits maintained an inhibitory level in the blood for 6-12 hours, as compared with 2 hours for the same dose of penicillin in saline. Injection of 41,000-66,000 units in 2-2.4 c.c. of beeswax oil into three human volunteers gave, it is said, "demonstrable blood levels for 6-7 hours and penicillin was present in the urine for 20-32 hours after the injections". There was no local pain or irritation. One dose of penicillin in beeswax oil was given to twelve patients with gonorrhoea and eleven were cured. Later a single injection cured fifty-three others (*Bull. U.S. Army Med. Dept.*, 1944, Oct., p. 42, quoted by the *Lancet*).

Because penicillin is thus rapidly excreted and because the supply of it is, in Great Britain at any rate, still limited, the need for economy of it has led to investigation of the value of local, rather than systemic, administration (*Brit. Med. J.*, 699, Nov. 25, 1944). H. B. May (*Brit. Med. J.*, 817, Dec. 23, 1944) reports on its use in private practice, concluding that the general practitioner will use penicillin creams more often than other preparations of it and that these should be made readily available; patients could use them themselves. H. B. May and D. Stern (*Lancet*, 83, Jan. 20, 1945) describe a rapid method for testing the sensitivity of organisms treated with antiseptic creams containing either penicillin, propamide, sulphanilamide, gentian violet, proflavine and other dyes. Another method of local application is by means of the penicillin pastilles for infections of the mouth and throat described by A. B. MacGregor and D. A. Long (*Brit. Med. J.*, 686, Nov. 25, 1944, and *Nature*, 201, Feb. 17, 1945). These authors had unsuccessfully tried sprays for acute tonsillitis. They found that a slowly dissolving pastille with a gelatin base, prepared without excessive heat, replaced by another when the first had dissolved, kept the saliva fully bacteriostatic. The standard dose adopted was 500 units in each pastille. The flora of the condition being treated, as well as the general flora of the mouth, were markedly affected. Prof. L. P. Garrod (*Brit. Med. J.*, 528, i; 1944) has noted that most of the bacteria found in the mouth are sensitive to penicillin. The penicillin pastilles seem to have controlled the oral sepsis in the relatively few cases treated by MacGregor and Long. The symptoms of Vincent's gingivitis (twenty-five cases), the treatment of which by other methods

had been unsatisfactory, cleared up the most rapidly of all. Both *Treponema vincenti*, the cause of this disease, and the symptoms, disappeared in 24 hours, and within five days the ulcerated areas had cleared up so well that the treatment was stopped. No recurrence had been noticed up to 3½ months later. Acute hæmolytic streptococcal tonsillitis (seventeen cases, including four cases of scarlet fever) seemed to respond clinically to the pastilles and the effect on the throat flora seemed to be rapid. Carriers of these streptococci (twelve cases) became negative during treatment, but when the pastilles were stopped, the infection reappeared. This method of using penicillin is clearly promising and, as these authors say, more work on it is required. It certainly seems more promising than the use of sulphonamides in the form of lozenges, for Capt. A. F. Hayden and Lieut.-Colonel J. W. Bigger (*Brit. Med. J.*, 81, Jan. 20, 1945) conclude that these are not satisfactory for the prevention of respiratory tract infections, including coughs and colds.

Yet another means of local application of penicillin are the penicillin lamellæ for eye affections described by Wing-Commr. J. C. Neely and Squad. Leader A. G. Cross (*Lancet*, 85, Jan. 20, 1945). These authors noted that solutions of calcium and sodium penicillin deteriorate, even at 0° C., and tend to become infected with organisms insensitive to penicillin. They devised lamellæ made with lactose, the use of which in a small number of cases suggests that they are as satisfactory as penicillin drops. They retained their potency for two months at room temperature. Gelatin lamellæ rapidly lost their potency. In an Annotation in the same issue, the *Lancet* (p. 92) remarks that expectations of the value of penicillin for eye infections may not be realized, but that it is the drug of choice for gonococcal ophthalmia neonatorum, and that it is valuable for chronic ulcerative blepharitis, acute gonococcal iritis and for severe infections and war wounds of the eye (given as an irrigation of the anterior chamber). On the other hand, Sir Arnold Sorsby and E. Hoffa (*Brit. Med. J.*, 114, Jan. 27, 1945) conclude, after treating forty-seven infants suffering from ophthalmia neonatorum due to the gonococcus and other organisms with penicillin drops in various concentrations, that penicillin, if it is in adequate concentration, appears to be effective against all the organisms which commonly cause ophthalmia neonatorum, and that the results obtained with it are of the same order as those obtained with the sulphonamides.

Penicillin, indeed, seems to have many advantages over the sulphonamides, its lack of toxicity being one of the greatest. The *Lancet* (55, Jan. 13, 1945) reviews research on the penicillin treatment of gas gangrene (see also *Nature*, 677, Nov. 25, 1944) and quotes work which indicates that penicillin is superior to the sulphonamides for the treatment of this condition. Its precise value requires, however, further elucidation. G. H. Tee (*Brit. Med. J.*, 118, Jan. 27, 1945) reports on the treatment of one case of meningococcal meningitis with penicillin, suggesting that, although penicillin given intramuscularly may not normally get into the cerebro-spinal fluid, it may do so under the abnormal conditions of meningitis. R. E. Rewell, in the same issue (p. 119), describes the treatment of one case of internal hydrocephalus, arising as a complication of pneumococcal meningitis, with penicillin and sulphathiazole. All cases of pneumococcal meningitis should, this author thinks, be given penicillin as soon as possible. G. LAPAGE.

BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION

THE twenty-fourth annual report of the British Electrical and Allied Industries Research Association (E.R.A./T. 352) summarizes the work which has been carried out during the year ended September 30, 1944, and again lists, by titles, the various research reports which have been issued during the year. The work is reviewed under the same eighteen major classifications as last year, among which dielectrics, electric control apparatus, and surge phenomena are prominent. The work of the Association has been carried on during the year by 111 active technical sections, committees, sub-committees and panels, and seventy technical reports on various subjects have been issued as compared with seventy-five in the previous year.

Two outstanding matters mark the conclusion of the Association's year. The first is the retirement of the director, Mr. E. B. Wedmore, and the second is the project for the establishment of new laboratory accommodation at Leatherhead. In view of the necessary expansion of research programmes and the need for achieving results in advance of the practical developments to which they apply, it is becoming increasingly evident that the limiting factor will be the shortage of adequately trained personnel, a condition which can only be relieved adequately by even more extensive pooling of problems of common interest. The Association has now secured control of some forty-seven acres of land at Leatherhead at a cost of about £25,000. Designs for the new laboratories, plant and office accommodation are in the hands of Mr. H. J. Rowse, who has already spent considerable time studying the nature of the activities of the Association's staff, so that the building arrangements may foster and facilitate their work. Plans will be ready for consideration at an early date.

Further diminution of enemy action in the London area and smoother working of industrial organizations to take care of war requirements has made possible some increased activity of committees, both those indirectly connected with war products and those concerned with essential contributions of the E.R.A. to all sections of the industry.

The latest agreement with the Department of Scientific and Industrial Research was due to terminate at the end of the year covered by the present report; but the agreements have been extended for a maximum period of two years. In doing so the Department restored the sliding-scale grant to the £1 for £1 basis. It has become apparent that many influential persons in the electrical industry who are not closely in touch with the details of technical and scientific developments are not fully informed of the nature and importance of the use that is made of the Association by the industry. To remedy this, and for the information generally of interested parties, a descriptive illustrated brochure entitled "Co-operative Electrical Research" (ERA/R619) has now been prepared and issued. This brochure deals with the past, present and future of electrical research, the activities of the E.R.A. and its association with other bodies in the industry, and an outline of some of the major researches carried out by the Association.

A detailed account of the technical and scientific activities of the Association during the year is given in the body of the report under numerous sectional head-

ings. The co-ordination of all research work connected with the applications of electricity to agricultural and horticultural work is now almost complete: plans have been prepared during the year for the establishment of a field station associated with the University of Reading, and a working liaison has been established with the Scottish Hydro-Electric Board.

Special attention has been given to research required for the further commercial development of gas-blast circuit breakers. The electric control apparatus section has prepared a further important series of reports for dealing with industrial explosion hazards. The importance of work on the creep of steels has been recognized by expansion of the scale of working at the National Physical Laboratory, and some success has been achieved in applying similar ideas in the study of insulating materials subjected to continued high mechanical stresses at working temperatures, a subject representing practically an unworked field until tackled by the Association.

Continuous attention has been given to the examination of new insulating materials and to the research necessary for their standardization, and generally to improvements in methods of selection and testing. The practical value of applying modern statistical and other scientific methods in the study of electricity supply technology is receiving increasing recognition, and when the War ends will, no doubt, be pursued on a more adequate scale. Several notable reports have been issued during the year applying to surge phenomena, transformer design and meter jewels. Work on interference with communication circuits which applied mainly to particular war products has led indirectly to an important new development affording a scientific basis for the design of ignition systems adapted to all types of engines and to varied working conditions.

CERAMIC SEQUENCES AT TRES ZAPOTES, MEXICO

THE second season's work of the National Geographic-Smithsonian Institution joint archaeological expedition to southern Veracruz in 1940 has now been described in Bull. 140 of the Bureau of American Ethnology*. Bull. 139, giving an account of the 1939 season's work by G. W. Weiant, has already been noticed in *Nature* (July 22, 1944, p. 124). The aim of the 1940 work, by Philip Drucker, was to follow up the preliminary exploration of 1939 with careful stratigraphical excavations, upon which a ceramic sequence could be based. The results indicate two considerable alterations in Weiant's succession. The evidence is not absolutely conclusive on every point, but it is sufficient to confirm the suggestion made in the previous notice that his publication was premature.

The chief result of the 1940 work was to mark the essential unity and continuity of the Lower, Middle and Upper Tres Zapotes 'periods', which are renamed 'phases' to emphasize the point, and to separate Weiant's Upper period into a true Upper Tres Zapotes phase and an unconformable "Soncautla Complex", consisting of cremated burials (the "cremated burials in covered bowls" of the previous notice) intruded into deposits of the Upper phase. The Tres Zapotes

period, *sensu stricto*, is shown to cover an occupation of long duration, after which the site was abandoned, and later used for the Soncautla burials for a short time. So far, the picture is entirely convincing; but Drucker also points out that he cannot confirm Weiant's division of the Middle period into *A* and *B* stages, admitting at the same time that this may be due to the absence of *A* deposits from the places excavated by him.

Much of the material found in the 1940 work consists of sherds, and this has imposed a simpler system of classification than Weiant's, in which a relatively small number of wares are based on characteristics of slip, vessel shape and paste. The distinguishing features of the Lower, Middle and Upper Tres Zapotes phases are clearly pointed out in terms of these wares. The figurines are divided into three main types; the first to appear, which persisted throughout, are hand-made and mostly solid, whereas the other two are found in the Upper phase only, one being hollow moulded and the other large and elaborately modelled by hand, with jointed limbs.

A tentative chronology of the site is sketched out, and in this connexion there are two strong indications of an early date in the complete lack of metal and of Plumbate and Fine Orange wares. The Lower Tres Zapotes phase is shown to be linked with the early Lowland Maya, to the exclusion of the early Highland cultures such as those of Monte Alban and the Valley of Mexico. It is suggested that it was in existence in the first century B.C. The Middle phase is essentially one of transition, but the Upper is marked by a large increase of Polychrome sherds, and the introduction of some new elements which, it is conjectured, may have diffused from Teotihuacan. The date of the close of the Tres Zapotes occupation is estimated in round figures as A.D. 1000. This was followed by a period long enough for the accumulation of a certain amount of humus, after which came the Soncautla burials, which are very tentatively ascribed to the thirteenth century.

This bulletin shows a very considerable improvement on No. 139 in the provision of scales on illustrations and plans. Three misprints in references to plates were noticed: plate 18 at the top of p. 41 should be 16, Plate 10 at the bottom of p. 43 should be 14, and plate 56 on line 9 of p. 84 should be 59.

G. H. S. BUSHNELL.

FORTHCOMING EVENTS

Saturday, March 17

BIOCHEMICAL SOCIETY (at the Middlesex Hospital Medical School, London, W.1), at 2 p.m.—Annual General Meeting.

INSTITUTION OF MECHANICAL ENGINEERS (GRADUATES' SECTION) (at Storey's Gate, St. James's Park, London, S.W.1), at 3.30 p.m.—Mr. A. H. Lloyd: "British Machine Tools during the War" (Annual Lecture).

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Prince's Gate, South Kensington, London, S.W.7).—Mr. L. V. Chilton: First Renwick Memorial Lecture.

Tuesday, March 20

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. A. C. Thaysen: "Food Yeast, its Nutritive Value and its Production from Empire Sources".

CHEMICAL ENGINEERING GROUP (SOCIETY OF CHEMICAL INDUSTRY) (joint meeting with the INSTITUTION OF CHEMICAL ENGINEERS) (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Industrial Research" (to be opened by Dr. E. W. Smith).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, O.M., Pres.R.S.: "Nerve Endings and Chemical Transmitters", (3) "Cholinergic Action in Nerve Ganglia. Motor Nerve Endings and Electric Organs".

* Smithsonian Institution: Bureau of American Ethnology. Bull. 140: Ceramic Sequences at Tres Zapotes, Veracruz, Mexico. By Philip Drucker. Pp. ix+155+65 plates. (Washington, D.C.: Government Printing Office, 1944.) 50 cents.

INSTITUTE OF ELECTRICAL ENGINEERS (RADIO SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Apprenticeship and Trainee Systems in the Radio Industry" (to be opened by Dr. J. Greig).

INSTITUTE OF THE PLASTICS INDUSTRY (at the Waldorf Hotel, Aldwych, London, W.C.2), at 6 p.m.—Mr. N. J. L. Megson: "Plastics at War".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. W. K. Fitch: "Pharmacists with the B.L.A.".

Wednesday, March 21

INSTITUTION OF NAVAL ARCHITECTS (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 12 noon.—Eighty-sixth Annual Meeting.

ROYAL INSTITUTE OF CHEMISTRY (joint meeting with the INSTITUTE OF PHYSICS) (at the Royal Institution, Albemarle Street, Piccadilly, London, W.1), at 2.30 p.m.—Prof. H. T. S. Britton: "The Mechanism of Electrode Measurements".

PHYSICAL SOCIETY (COLOUR GROUP) (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 3 p.m.—Dr. R. K. Schofield: "The Presentation of the C.I.E. System of Colour Specification".

ILLUMINATING ENGINEERING SOCIETY (joint meeting with the ROYAL METEOROLOGICAL SOCIETY) (in the large Physics Lecture Theatre at the Imperial College of Science, Imperial Institute Road, South Kensington, London, S.W.7), at 5.30 p.m.—Mr. J. M. Waldram: "Measurement of the Photometric Properties of the Upper Atmosphere".

Thursday, March 22

LINNEAN SOCIETY OF LONDON (joint meeting with the ZOOLOGICAL SOCIETY OF LONDON) (at Burlington House, Piccadilly, London, W.1), at 4 p.m.—Mr. I. H. Burkill: "Abnormal Gamopetalous Flowers of the Poppy, *Romneya Coulteri*, and the way in which its Sepals Protect the Sexual Organs"; Prof. D. M. S. Watson, F.R.S.: "Evolution of the Elephants".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Lawrence Bragg, F.R.S.: "Some Physical Problems of the Solid State".

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6.30 p.m.—Mr. R. H. Bound: "Hydraulics for Aircraft".

Friday, March 23

ASSOCIATION OF APPLIED BIOLOGISTS (joint meeting with the GENETICAL SOCIETY) (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 11 a.m. and 2.15 p.m.—Symposium on "Genetical Relations of Plants and Animals to their Pests and Diseases" (Speakers: Dr. C. D. Darlington, F.R.S., Dr. J. Hammond, F.R.S., Mr. M. S. Pease, Mr. J. G. Carr, Mr. W. Black, Mr. G. Cockerham, Mr. T. J. Jenkin and Dr. C. B. Williams).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Sir Richard Paget, Bart.: "Is Human Speech Good Enough?"

INSTITUTION OF MECHANICAL ENGINEERS (joint meeting with the INSTITUTION OF ELECTRICAL ENGINEERS) (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. W. B. Shannon, Mr. C. W. Pratt, Mr. T. B. Webb and Mr. W. B. Carlson: "Expanded Tube Joints in Boiler Drums—with Special Reference to the Battersea High-Pressure Boilers".

Saturday, March 24

ASSOCIATION OF BRITISH ZOOLOGISTS (at the Zoological Society of London, Regent's Park, London, N.W.1), at 10 a.m.—Tenth Annual General Meeting; at 10.30 a.m.—Dr. C. F. A. Pantin, F.R.S.: "The Interrelationship of Biology Teaching in Schools and Universities"; at 2 p.m.—Dr. Stanley Kemp, F.R.S.: "Marine Investigations"; at 2.45 p.m.—Dr. S. A. Neave: "The Work of the Zoological Society"; at 3.30 p.m.—Mr. J. C. F. Fryer: "Zoological Interests of the Agricultural Research Council"; at 4.15 p.m.—Dr. E. B. Worthington: "Freshwater Investigations".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Mr. J. H. Ridley: "An Experimental Approach to Time Lapse Cinematography".

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SOUTH YORKSHIRE SECTION OF THE ROYAL INSTITUTE OF CHEMISTRY) (at 193 West Street, Sheffield, 1), at 2.30 p.m.—Dr. U. R. Evans: "The Principles governing Corrosion Resistance in Metals and Alloys".

APPOINTMENTS VACANT

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

ENGINEER AND MANAGER—The Clerk to the Alderley Edge and Wilmshw Electricity Board, 49 Spring Gardens, Manchester 2 (March 21).

ANIMAL HUSBANDRY OFFICER—The Executive Officer, Cornwall War Agricultural Executive Committee, County Hall, Truro (March 21).

ASSISTANT VETERINARY INVESTIGATION OFFICER at the University Agricultural Advisory Centre—The Secretary and Registrar, The University, Bristol (March 24).

PRODUCTION OFFICERS IN THE DEPARTMENT OF AGRICULTURE, Government of Nigeria, for Agricultural Surveys connected with investigations of Diseases of Cocoa—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. F.3752.A) (March 24).

GRADUATE ASSISTANT to teach MATHEMATICS and SCIENCE—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middlesex (March 26).

LECTURER IN BIOLOGY in the Cardiff Technical College—The Director of Education, City Hall, Cardiff (March 28).

RESEARCH OFFICER on the staff of the Council for Scientific and Industrial Research (Division of Industrial Chemistry), Melbourne, for research work in CERAMICS—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (April 2).

LECTURER (full-time) IN CHEMISTRY in the Department of Chemistry, Leeds College of Technology—The Director of Education, Education Offices, Leeds 1 (April 7).

MATHEMATICS SPECIALIST (permanent) to teach up to Higher School Certificate and University Scholarship standard, and an ASSISTANT (temporary) to teach BIOLOGY and CHEMISTRY to Junior Forms, in the Varndean School for Boys—The Education Officer, 64 Old Steine, Brighton (April 7).

PHYSICIST (full-time) at the Radiotherapeutic Centre—The Secretary-Superintendent, Addenbrooke's Hospital, Cambridge (April 7).

LECTURER (full-time) in PHYSICS—The Principal, College of Technology and Commerce, The Newark, Leicester (April 9).

ASSISTANT LECTURER AND DEMONSTRATOR (woman) IN BOTANY—The Principal, Royal Holloway College, Englefield Green, Surrey (April 21).

SECRETARY TO THE SENATE—The Principal, University of London, c/o Richmond College, Richmond, Surrey (April 30).

TUTOR IN PHYSIOLOGY—The Principal, Lady Margaret Hall, Oxford (April 30).

LECTURER, and an ASSISTANT LECTURER AND DEMONSTRATOR, in the DEPARTMENT OF PHYSICS—The Registrar, University College, Cathays Park, Cardiff (April 30).

PRINCIPAL—The Secretary, King's College of Household and Social Science, c/o University College, Leicester (May 1).

UNIVERSITY CHAIR OF BACTERIOLOGY tenable at University College Hospital Medical School—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (June 25).

TEACHER (full-time) OF PHYSICS AND MATHEMATICS—The Clerk, Northern Polytechnic, Holloway Road, London, N.7.

SPEECH THERAPIST—The Education Officer, County Hall, Wakefield, Yorks.

PSYCHOLOGIST (part-time) to the Child Guidance Clinics at Huyton and Atherton and Ashton-under-Lyne—The County Medical Officer of Health, School Medical Department, County Offices, Preston.

BOROUGH ENGINEER AND SURVEYOR—The Town Clerk, Town Hall, Wallasey.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Canterbury Schools: King's School and St. Edmund's. Report on Natural History, Cornwall 1940-1944. Pp. 44. (Canterbury: King's School, 1945.) [122]

Institution of Professional Civil Servants. Post-War Organisation of Statistics in Government Departments. Pp. 16. (London: Institution of Professional Civil Servants, 1945.) [122]

The Importance of Power Unit Development. By Air-Commodore F. R. Banks. Pp. 20. (London: Royal Aeronautical Society, 1945.) [132]

Aeroplane Wheels and Brakes. By J. Wright. Pp. 10. (London: Royal Aeronautical Society, 1945.) [132]

Ministry of Agriculture and Fisheries. Bulletin No. 123: Diseases of Vegetables. By Lawrence Ogilvie. Second edition. Pp. ii+74+8 plates. (London: H.M. Stationery Office, 1944.) 1s. 6d. net. [142]

Carnegie Trust for the Universities of Scotland. Forty-third Annual Report (for the Year 1943-44) submitted by the Executive Committee to the Trustees on the 12th February 1945. Pp. iv+62. (Edinburgh: Carnegie Trust for the Universities of Scotland, 1945.) [142]

Other Countries

Meddelanden från Lunds Universitetets Matematiska Seminarium. Band 6: On a Class of Linear Transformations Connected with Group Representations. By Lars Gärding. Pp. 125. (Lund: C. W. K. Gleerup, 1944.) [241]

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 40: Two Extraordinary New Blind Nematognath Fishes from the Rio Negro, representing a New Subfamily of Pygididae, with a Rearrangement of the Genera of the Family, and Illustrations of some previously described Genera and Species from Venezuela and Brazil. By George Sprague Myers. Pp. 591-602+plates 52-56. (San Francisco: California Academy of Sciences, 1944.) [311]

Proceedings of the United States National Museum. Vol. 95, No. 3180: Studies in Neotropical Mallophaga (III) (Tinamidæ No. 2). By M. A. Carriker, Jr. Pp. 81-233. (Washington, D.C.: Government Printing Office, 1944.) [311]

Scientific Research in India. By Prof. A. V. Hill. Pp. 40. (Simla: Government of India Press, 1944.) [311]

Indian Forest Leaflet, No. 69: A Note on the Protection of Timber from Certain Borers. By J. C. M. Gardner. Pp. ii+4. (Dehra Dun: Forest Research Institute, 1944.) 4 annas; 6d. [12]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 142: A Soil and Land Use Survey of the Hundreds of Riddoch, Hindmarsh, Grey, Young, and Gungahray, County Grey, South Australia. By C. G. Stephens, R. L. Crocker, B. Butler and R. Smith. Pp. 55+6 plates. Bulletin No. 152: Soil Survey of part of County Moira, Victoria; including the Parishes of Boosey, Cobram, Katamatite, Naringaningalook, Katunga, Yarraweah, and Strathmonton. By B. E. Butler, J. G. Baldwin, F. Penman and R. G. Downes. Pp. 48. Bulletin No. 182: The Effectiveness of Various Mineral Dusts for the Control of Grain Pests. By Dr. J. S. FitzGerald. Pp. 27. (Melbourne: Government Printer, 1941, 1942, 1944.) [12]