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

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INDUSTRIAL ADMINISTRATION AND ECONOMIC POLICY

FAR more effectively than the Limitation of Supplies Orders or the policy of concentration of production already announced by the President of the Board of Trade, the rationing of clothing in Great Britain has brought home to every member of the community the importance of utilizing to the maximum advantage all our resources of moneys, materials and man- or woman-power. The contribution and co-operation of the individual citizen are essential, but our war effort may fail of its full effect if they are not directed and utilized to the utmost by wise administration and skilful management, whether on the part of Departments of State or in industry. The significance of scientific management and sound administration can scarcely be overstressed. They affect most powerfully the morale of the general population, which in total war is of as much importance as maintaining morale in the fighting services.

There are, unfortunately, many signs that this is far from being generally realized, or at any rate invariably served, by management or administration, as recent reports of the Select Committee on National Expenditure indicate. Its recommendation that day-time manning strengths in the civil defence services should be reduced to the minimum consistent with safety was prompted largely by the importance of minimizing the detrimental effect on morale and efficiency of an unnecessarily large amount of standing-by and waiting. The severity of its censure on the Ministry of Health for failure to supply information which would permit a judgment as to whether nursing staffs in the emergency hospital service are excessive is to be attributed as much to the desire to avoid waste and damage to morale of staff kept standing by unnecessarily, while similar staff elsewhere is overstrained, as to the ineptitude and incompetent administration thus revealed.

Other disclosures of the detrimental effect of inefficient administration on economy are contained in the twelfth and fifteenth reports of the Committee. In the former, sharp comment is made on the deterrent effect, as regards suggestions for increased economy and efficiency, of the cumbrous machinery through which these suggestions have to pass before reaching a level at which decisive action can be taken. Sensible suggestions, moreever, have been turned down as a matter of routine, apparently before reaching an officer who was sufficiently informed to appreciate them. In the matter of complaints, this position leads to the

more vigorous or influential complainants taking undesirable short cuts to overcome their personal difficulties, and it does not appear that the administration has been sufficiently wise to appreciate the way in which this state of affairs merely increases the difficulties of others, engenders friction and reduces general efficiency.

Other indictments of administrative neglect of elementary principles of scientific management are seen in the fact that valuable information can often only be acquired by direct contact with those who have to give practical effect to decisions and are usually working away from headquarters, and the Committee comments that, however effective may be the various means of collecting information, this work will be wasted unless its results are rapidly brought to the notice of those who have power to decide what modifications of practice and policy may be immediately required.

The Select Committee points out that apart from the failure of information and criticism to percolate from those actually carrying out the work to those who are directing and controlling it at the centre, highly placed witnesses have made statements which suggest either that they are unaware of some of the relevant facts and considerations, or that they have not fully appreciated their practical significance. It is sometimes difficult to escape the impression that they work in an atmosphere which is too strongly buffered from outside impacts. Moreover, the Committee stresses the great importance that the facts which it has readily been able to collect, but which, under war conditions, it is unable to support by full publication of the evidence taken, should have been collected, sifted and studied by responsible officers in the departments. Only in this way can recommendations for reducing waste by increasing efficiency of management be judged in their correct setting.

Whereas the disclosures in the fifteenth report are primarily those of failures of human nature, the need for effective administration is no less clearly indicated. The suggestion that idle labour was becoming a permanent and undesirable feature in the aircraft industry generally is disturbing, and all the more in the evidence of management so inept that it failed to keep the essential records which the Select Committee has now recommended should be enforced. Similarly, the recommendations that the Ministry of Labour should endeavour by publicity to give women a better idea of the kind of factory work for which they are needed, that Sunday labour should be discontinued except for the maintenance and repair of plant and other essential purposes, and that the Ministry of Aircraft Production should do everything in its power to ensure that factories working for it, either commercially or on a management fee basis, observe district federation wage-rates and keep their bonus percentages in line with those of their neighbours, involve essentially reflections on the foresight, imagination and competence of the administrations concerned.

It would be unfair to suggest that the question of absenteeism, which the Select Committee finds so disturbing, is one for management alone. With so much evidence of inefficient, if not incompetent management, however, it is difficult to believe that improvement in this respect and the maintenance of a more scientific standard would not go far to reduce avoidable absenteeism to a figure when it should easily be possible to deal with recalcitrant elements in personnel. In any event, we cannot afford in war-time to tolerate ineptitude and incompetence in management. The Select Committee's reports alone afford sufficient evidence of the waste and difficulties which flow from this source.

Unquestionably these reports indicate that civil administration in Great Britain is far from attaining the standard that the country has a right to expect. The restrained criticism is a severer indictment of civil service efficiency than such violent attacks as those of Lord Percy, and it would be reassuring to learn what action has been taken upon recommendations so authoritatively prepared and objectively stated. Nor is the indictment of industrial management any less penetrating, and it is scarcely reassuring to find, in view of the shortcomings of industrial management simultaneously exposed, that leading positions in the Ministry of Supply, the Ministry of Aircraft Production, the Ministry of Food and the ministries concerned with economic reconstruction have been entrusted to representatives of industrial organizations, rather than to individuals on their outstanding ability.

It is for this reason that Mr. Hugh Quigley's pamphlet in "The Democratic Order" series* is timely. He subjects the whole structure and policy of industry in relation to efficient administration and control to analysis from the point of view of serving the needs of the community—the *raison d'être* of industry in the ultimate analysis. Funda-

* End Monopoly Exploitation: a Policy for Industry. By Hugh Quigley. (The Democratic Order, No. 15.) Pp. 63. (London: Kegan Paul and Co., Ltd., 1941.) 1s. net.

mentally he raises the question, not so much of industrial policy, as of the machinery of government and its adequacy under present and post-war conditions.

Mr. Quigley makes his first important point in suggesting that the present industrial order should be replaced by one in which industry is subordinate to the State, in so far as the State seeks to advance the public welfare, and in which industry does not at any point dominate the public, either through its organizations or through its methods of representation. This involves a sense of public responsibility as well as of efficient management which have not been approached even by the new types of public corporation. As Mr. Quigley points out, where such authorities as the British Broadcasting Corporation, the Central Electricity Board or the London Passenger Transport Board have failed, has been in their approach to the larger problems of public service which give the justification for their technical privileges. We can scarcely expect more of the executives of the industries bordering on coal-mining, building, iron and steel, chemicals, shipbuilding, electrical engineering, agricultural, or the distribution of foodstuffs, especially in the light of the evidence of the Select Committee on National Expenditure reports.

This judgment, however, narrows the problem to one not so much of executive ability or technical efficiency as to one of managerial responsibility and executive vision, and Mr. Quigley points out first that the character of new State enterprises such as the public utility companies tends to reflect the character of the national executive, and that accordingly some kind of division must be made between purely technical management, which is usually efficient, and the wider aspects of national policy which are expressed in such management. The nature and limitations of any organization created to obtain better results from the point of view of the public welfare are a matter for investigation and, for all his insistence on the necessity for some such development, Mr. Quigley is unconvinced that far-reaching nationalization is the remedy.

The great difficulty is that of higher control; this has never been adequately considered by those who advocate the most thorough-going socialization. Moreover, attempts to co-ordinate economic policy are faced with the absence of any conception of what the tactics of higher control in economic matters should be. This is the real reason for the confusion existing, for example, in agriculture and in the marketing and distribution of food.

If we accept as basic the principle that no public utility or industry should be allowed to have a vested interest other than that involved in efficient production, a considerable amount of well-defined and well-supported technical, economic and social research will be required before we can evolve the technique and policy for the higher impartial controlling authority, which must possess not merely advisory functions, but also full executive powers. It involves, indeed, reconsideration of the whole machinery of government. It will be recalled that the Haldane Committee, which clearly envisaged this problem, while firmly rejecting a proposal to concentrate the administration or supervision of private enterprise in production under the same department concerned with the administration of nationalized services, contemplated some development of the Board of Trade in this field of production, but laid its main stress on the need for further provision in the sphere of civil government for the continuous acquisition of knowledge and the prosecution of research to furnish a proper basis for policy.

Mr. Quigley takes no pessimistic view of the capacity of democratic government to evolve the appropriate instruments to prevent in future the development of industry without regard to the needs of the community. Protection against exploitation, increasingly high standards of public service on the part of industries and public utilities and the right to call to account, as those in military or naval command are called to account, those in charge of such industries and public utilities if their administration fails to display courage, vision or disinterested statesmanship—these are no Utopian ideals. Despite all the evidence of inefficiency or negligence or disregard of public interest, there is no sign that the community is unable to throw up, either in the service of the State or of industry, those possessing administrative ability, high ideals, wide vision and unassailable integrity. The fields of thought and inquiry opened up by Mr. Quigley and by the Select Committee's reports go far beyond the structure of industry and organization of government: they embrace the whole character of our educational system and its capacity to throw up leaders. That these suggestions should be voiced, however, attests the vitality of democracy and its capacity of adjustment and development to meet the changing needs of a dynamic society.

SCIENCE AND THE STRUCTURE OF SOCIETY

The Social Relations of Science

By J. G. Crowther. Pp. xxxii+665. (London: Macmillan and Co., Ltd., 1941.) 16*s*. net.

WHEN, eighty years ago, H. T. Buckle wrote his "History of Civilization in England", his main thesis was that the course of human progress could be traced in the growth of scientific truth. He applied scientific principles to the study of history, but measured progress too much by materialistic achievements for his analysis of causes to be accepted by historians as complete. Mr. J. G. Crowther takes a truer and broader view of the social and intellectual influences of natural knowledge, and is not so much concerned with maintaining a proposition as in presenting a picture of creative scientific thought and action. He has long been esteemed as a clear interpreter of scientific developments to general readers, through his articles in the newspaper press and other literary works; and he realizes fully the relations between these advances and the structure of society.

The theme of Mr. Crowther's book is essentially that of Francis Bacon's phrase: "All knowledge should be referred to use and action." This maxim is, however, not fully representative of Bacon's regard for the pursuit of knowledge as an end in itself, and the expression of a natural desire to discover the truth by experiment. His words, "Itaque ipsissimae res sunt (in hoc genere) veritas et utilitas", in Aphorism cxxiv of the "Novum Organum", have been variously rendered, but their meaning is "Truth and utility are in this kind the very things we seek for".

Whether or no Bacon held more liberal views of the relation between knowledge and practice than are expressed in the phrase which is the keynote of Mr. Crowther's book is, however, unimportant. It is contrary to the spirit of modern science to be bound by the words of any master; and the story of progressive knowledge and changing social conditions told impressively in the book implies nothing of this kind. It is a concise survey, under eighty-three headings, of the repercussions of science and society from the time when man became a tool-making animal to the present day. Man had to acquire knowledge of the properties of things around him in order to supply his daily needs. His primary purpose was "use and action", but this was often diverted into new directions by innate curiosity and the desire to control mysterious characteristics of natural objects and events. As a craftsman, he was concerned with applications of science and manual skill rather than with the philosophy of causes and consequences, which belonged to the fields of magic and religion.

Early man learned by practice how to increase food supply by the cultivation of plants and the domestication of animals, and by the invention of the bow for hunting and protection. He began to learn how to be master of Nature instead of her servant. The scope of interest and activity expanded from the family to the village and then to urban cities in the great river valleys of the Nile, Euphrates and Indus, with a consequent growth of specialization of function and increase of social authority. With this expansion were associated the concentration of wealth and distinctions of social status between craftsmen of various types and other members of the community. The introduction of organized warfare to extend possessions brought captives as well as land and booty. The captives became slaves; and the manual work involved in the crafts of metal-working, weaving, pottery and like creative activities lost its social dignity.

"The notable decline of invention", says Mr. Crowther, "after the stabilization of city life in Babylonia and Egypt occurs in parallel with the increase of slavery, the loss of status of craftsmen, and the concentration of wealth." He traces this decline through the classical period of Greece and Rome, when manual workers were of the slave class and most of the inventions were made by them. Concentration by the Romans upon law and administration led to the distinction "between the creative and organizing factors in civilization, which still persists, and is one of the causes of modern social disorder". Plato taught that pure science was a subject for gentlemen, and practical applications of knowledge were for people of a lower standard. He used the same Greek word in referring to the manual operations in surgery as in carpentry, with the result that the influence of his teaching led surgery to become the profession of barbers. Though Galen made his own dissections, his successors relegated them to slaves and servants because of the low esteem in which manual work of any kind was held.

It was a village carpenter, Jesus of Nazareth, who by his ethical teaching and noble life established a social philosophy in which the manual worker was again given his rightful place in society. "The Christian doctrine of human equality has had profound influence on the restitution of the dignity of human labour and this indirectly on

experimental science." It cannot be said that Christian civilization to-day, or at any time, has seen the fulfilment of the teaching of its Founder, but it represents a vast advance upon the conditions of life and service which prevailed in Græco-Roman times. Its defects are due not to faults in the humane principles of its message, but to the neglect to put them into practice. Lust for power and property, in individuals and in communities, is similarly responsible for the perversion of the gifts of science. Scientific workers are, however, beginning to realize that they have a social mission to undertake, as well as the right to pursue natural knowledge as an intellectual activity or with practical purpose in mind.

Mr. Crowther's suggestions as to the organization of scientific work on the basis of Bacon's maxim of "use and action" will not be readily accepted by those who believe in the pursuit of knowledge for its own sake, without regard for its proximate or ultimate service to the community, but the deplorable social and international conditions in the world to-day demand that heed should be given to them. His book is a thoughtful and thought-provoking sketch of the influence of science upon society and of society upon science. The apostle whom he follows is Bacon, whose insight into the social relations of science led to the foundation of the Royal Society. The early interests of the Society were in investigations planned to benefit mankind, but after a time they became specialized and professionalized, and the social contacts were correspondingly diminished. Mr. Crowther sees in the scientific movement in recent years, represented in addresses of presidents of the Royal Society and the British Association, and by the formation of the Association's Division for Social and International Relations of Science, signs of a revival of the Baconian principles of service. His interesting and stimulating book should help to dispose of the remark that "We learn from history, that we do not learn from history".

R. A. GREGORY.

BIOLOGICAL OXIDATIONS

Mechanisms of Biological Oxidations

By David E. Green. (Cambridge Biological Studies.) Pp. vi+182. (Cambridge: At the University Press, 1940.) 12*s*. 6*d*. net.

THE study of the mechanisms of biological oxidations has made such rapid strides during the last fifteen years that adequate reviews of the progress made are most welcome. Dr. Green's book gives a readable and concise account of many of the major advances which have been made recently in the field of biological oxidations.

The enzymes, important in oxidative systems, which Dr. Green describes are prefaced by a short introduction to the general properties of enzyme systems. The introduction resolves itself into a survey of the properties of amino-acid oxidase, an enzyme found in kidney extracts. This enzyme is chosen to familiarize the reader with the properties of oxidative enzymes, on the grounds that its general properties " may be assumed to parallel those of other oxidative enzymes". It is, however, unfortunate that Dr. Green should have chosen this example as a typical oxidative enzyme, for the amino-acid oxidase of tissue extracts is confined in its activities to the oxidation of the unnatural amino acids (that is, of the *d*-configuration). It must, therefore, be regarded as distinct from most other oxidative enzymes which attack naturally occurring substances. The enzyme has other properties not shared by most other oxidative enzymes; for example, it is able to attack a large number of substances having a special configuration, a property shared by hydrolytic enzymes and certain oxidative enzymes, but not shown by a large number of oxidative enzymes the most striking property of which is their specificity of attack; again it forms hydrogen peroxide as a result of its oxidative activity, a property shown by enzymes such as amine, choline and xanthine oxidases but not by the majority of dehydrogenases.

Possibly the property which Dr. Green is most anxious to demonstrate in the enzyme, the properties of which are assumed to parallel those of other oxidative enzymes, is the fact that the enzyme can be resolved reversibly into two constituents, a protein and a yellow compound neither of which is catalytically active but together form the active enzyme. The yellow compound, shown to be a flavin adenine nucleotide, has been termed a prosthetic group of the amino-acid oxidase. Many oxidative enzymes are now known to be capable of dissociation into a protein and a substance the chemical structure of which is known. Neither the protein nor the dissociated substance—the 'prosthetic group'—has catalytic properties; the combination of the two apparently constitutes the enzyme. This interesting fact,

made clear by the work of Warburg and of Euler, forms the main theme of Dr. Green's book.

Dr. Green considers that the oxidative enzymes are best classified by reference to the chemical nature of their prosthetic groups, and is evidently more concerned with such a classification than with any attempt to describe the enzymes with reference to their share—quantitatively as well as qualitatively—in the oxidative metabolism of the living cell.

The enzymes are named, following Warburg's nomenclature in describing enzymes, according to the chemical nature of the prosthetic group. They are grouped into the following classes :

1. *The iron porphyrin protein enzymes*—so called because the prosthetic group is iron porphyrin. These include catalase and peroxidase.

2. *The pyridine protein enzymes.* Here the prosthetic group is a compound of nicotinamide, ribose, phosphoric acid and adenine. The enzymes include a large number of the well-known dehydrogenases.

3. *The flavoprotein enzymes.* The prosthetic group is a compound of flavin, ribose and phosphoric acid. Adenine may also enter into the composition of the prosthetic group. These enzymes are responsible for the activation of *d*-amino acids, dihydrocozymase and probably of xanthine, hypoxanthine and certain aldehydes.

4. *Copper protein enzymes*—so called because copper appears to be indispensable for the activity of the enzymes and is united with the special proteins involved. Such enzymes are polyphenol and monophenol oxidases, laccase and ascorbic acid oxidase.

In all cases the highly specific structures of the enzymes are the proteins, one prosthetic group being capable of combining with a number of different proteins and forming different catalytic systems.

The adoption of the Warburg nomenclature is still clearly a matter for argument. It facilitates at present a certain clarity of exposition but its implications are such as not to be accepted by all workers in the subject.

Further chapters in Dr. Green's book deal with what are termed thiamino proteins, that is, enzymes such as carboxylase and pyruvic oxidase which require the presence of thiamine (or vitamin B_1) pyrophosphate for their activities, and with enzymes which Dr. Green finds difficulty in classifying but are grouped together as they all seem to reduce cytochrome in presence of their respective substrates without the necessity of an intermediate carrier. There is finally a block of enzymes which apparently defies attempts at classification and these are put by Dr. Green in a chapter entitled "Unclassified Oxidative Enzymes".

It is important to point out that this account of enzymic oxidations is limited largely to one aspect of oxidative phenomena, namely to those reactions taking place in tissue extracts or in isolated enzyme systems. The result of this limitation of treatment is that in a book consisting of 178 pages of text, 163 pages are devoted to descriptions of the properties, and the modes of preparation, of a variety of isolated oxidative enzyme systems, whilst the remaining pages are concerned with brief comments on oxidations as they are known to occur in intact animal tissues. Dr. Green remarks (p. 164) " there is a tendency for those who are engaged in the reconstruction of cellular oxidations to forget that the countless chemical permutations and combinations, of which the isolated components of oxidative systems are capable, cannot be assigned physiological significance until some counterpart of these events is shown to take place in the intact cell or organism. It is becoming increasingly clear that the study of enzyme systems cannot be divorced from the study of the intact cell and *vice versa*." It is a pity, in view of such a commendable statement, that Dr. Green has not paid at least as much attention to the experimental facts bearing upon oxidations as they occur in intact cells and tissues as he has to the phenomena observed in isolated enzyme systems.

In a book of this nature, where most prominence is given to the enzymes the prosthetic groups of which have been the subject of much investigation, it is natural that there should be many omissions. It is, however, surprising that so little mention is made of the work on tyrosinase and melanin formation, that no reference is made to the mutual oxidations and reductions undergone by amino acids in presence of strictly anaerobic micro-organisms—reactions which are vital for the proliferation of these cells—that in a discussion devoted to glycolysis and fermentation no mention is made of the enzyme hexokinase, which transfers phosphate from adenylpyrophosphate to glucose or fructose and so on.

There are certain errors in the text requiring alteration. Thus on p. 25, line 22, " 10 g." should read " 50 g." and on page 113 there is a curve which may lead one to suppose that the copper content of polyphenol oxidase may reach 300 per cent!

Dr. Green's book must be considered of real value to the teacher and to the more advanced student of biochemistry, so long as the limitations which have been expressed above are recognized.

The book is well printed and produced. It is a pity, however, that its cover should be spoiled by some obvious misprints.

J. H. QUASTEL.

NORTH AMERICAN HARDY TREES AND SHRUBS

Manual of Cultivated Trees and Shrubs Hardy in North America

Exclusive of the Subtropical and Warmer Temperate Regions. By Prof. Alfred Rehder. Second edition, revised and enlarged. Pp. xxx+996. (New York: The Macmillan Company, 1940.) 42*s*. net.

THE first edition of this notable work appeared in 1927 and set a new standard for its kind. A nineteen-page supplement of corrections and emendations appeared in 1935. The original issue is now exhausted, and as in the interval new species and hybrids have been named and introduced and the cultivation of others extended, the new edition now includes more than 2,500 species fully described, with 2,685 varieties, and 1,940 species and hybrids briefly mentioned.

The small half-page map illustrating zones of hardiness in the United States has been replaced by one partly coloured facing the title-page. In the process of revision certain alterations have been made. Monocotyledons have been placed at the end instead of immediately preceding the Dicotyledons, and the bamboos subdivided into ten instead of three genera. Original authors are cited in parenthesis (for example, *Petrophytum cæspitosum* (Nutt.) Rydb.), a practice which may assist in tracing descriptions or illustrations. Varietal and other subdivisional epithets now immediately follow the specific name, the category proposed by the first author of a trinomial being placed immediately after it (for example, *Ribes alpestre giganteum* Jancz., var.). This is to avoid making numerous new combinations, since the author does not always agree with the conclusions of other botanists.

Sequoiadendron has been separated from Sequoia, Halimium from Helianthemum, and Weigela from Diervilla, all with good reason. There is a considerable increase (twenty-four species) in Rhododendron, reflecting the spread of this genus into American gardens. Some additions noticed are *Carmichælia australis*, the hybrid *Caryopteris clandonensis*, the monotypic genus Kalmiopsis, the bi-generic hybrids Gaulthettya and Pyracomeles, etc.

It is Prof. Rehder's intention, however, to publish a bibliographical supplement which will include not only exact citations of their source for all names and important synonyms mentioned in the "Manual", including both varieties and forms which are often difficult to trace, but also, in the case of trinomials, the category considered to be botanically correct.

In a work of this magnitude and detail typographical and other errors are almost unavoidable, although of the former many have been corrected since the earlier edition. Muhlenbeckia instead of Muehlenbeckia in the index, on p. 579 Parsonii for Parsonsii, and on p. 887 *Bambusa metake* for Metake are examples.

The spelling of certain specific names is apparently not always in accordance with the Rules. Instances are *Pyrus kumaonensis*, *Rhamnus Erythroxylon*, *Rosa Lheritierana* and *Spiræa Billiardii*.

A few authors are incorrectly cited, for example, *Prunus tangutica* Batal., for Koehne, *Lavandula latifolia* Vill., not Linn., and *Daphne hybrida* Sweet, not Lindl. Some recent changes in nomenclature have not been taken up, such as *Magnolia heptapeta* (Buc'hoz) Dandy, *Betula platyphylla* Sukatchev for *B. mandshurica* (Reg.) Nakai, and *Ulex minor* Roth for *U. nanus* Forst. The dates of introduction to cultivation are not always accurate; for example, *Forsythia Giraldiana* was introduced by Farrer in 1914, *Euonymus oresbius* and *Berberis sublevis* by Forrest about 1919, whilst Orphanidesia has been growing in England for some years, although only lately figured. The flowers of *Magnolia Dawsoniana* are now known and have been described. On p. 562 the derivation of Glossopetalon is supplied instead of *Forsellesia*, and *Rubus japonicus* Linn. is cited on p. 406 as a synonym of *Kerria japonica* (Linn.) DC., instead of the much more common *Corchorus japonicus* Thunb.

For the most part, however, these are comparatively small points which can be corrected as they are discovered. A more definite want, particularly to British users of the book, is the omission of a number of genera and species hardy in many parts of these islands and almost certainly equally hardy in Zone VII of Prof. Rehder's map. Azara, Desfontainea, Fabiana, Corokia and Mutisia come to mind, while *Cytisus Battandieri*, *Ceanothus rigidus*, *Telopea truncata* and *Viburnum Tinus* should certainly be included.

Apart from these criticisms it is scarcely possible to over-estimate the value of this comprehensive and laborious work to those whose work or hobby brings them into close contact with trees or shrubs. Nurserymen, botanists, foresters and amateur gardeners can all learn from it, and if it was more widely utilized there would be a great improvement in the general nomenclature of woody plants in cultivation. The new "Manual" is a most welcome addition to the bookshelf, and will become the same guide and authority which its predecessor has been.

B. O. MULLIGAN.

TSWETT'S ADSORPTION ANALYSIS

Principles and Practice of Chromatography
By Prof. L. Zechmeister and Dr. L. Cholnoky. Translated from the second and enlarged German edition by A. L. Bacharach and F. A. Robinson. Pp. xviii+362. (London: Chapman and Hall, Ltd., 1941). 25*s*. net.

THE removal of coloured impurities from solutions by shaking with charcoal is the most familiar application of adsorption, and chemists have shown enterprise in improving the adsorbent by 'activation' and in finding new ways of using the material. In applying adsorption to analytical problems, however, it was left to a botanist, Prof. M. Tswett, to display initiative and imagination and present chemists with a device of great value. He allowed coloured solutions to percolate through a compressed column of adsorbent, and by using finely divided calcium carbonate instead of charcoal, he was able to follow visually the track of the pigments. Different coloured substances travelled down the column at different speeds and the resulting separation into coloured zones could be enhanced by 'developing the chromatogram', that is, by allowing sufficient of the pure solvent to pass down the column after the solution had all come into contact with the adsorbent.

The possibilities of the new method were recognized very slowly. Tswett's monograph entitled "Chromophylls in the Plant and Animal Worlds" (Warsaw, 1910) was published in Russian, but the neglect of his work was not really due to inaccessibility because it was described in several papers in well-known German journals during the period 1906–12. Even the encomiums of Willstätter and Stoll in 1910 and 1912 made little impression, and it was not until 1931, when Kuhn and his colleagues succeeded in isolating pure α- and β-carotene by the use of the method, that Tswett's procedure came into its own. Nor can it be said that the potentialities of the method were unforeseen, for Tswett had himself predicted on good evidence, so early as 1910, that 'carotene' could be separated in this way.

The neglect which is often the fate of a new device or technique arises more often than not from what is practicable in research rather than from dullness of mind. Three advances contributed to the new interest in Tswett's work; the first was Pregl's in the technique of microanalysis, the second the discovery that carotene was somehow connected with vitamin A, and the third was that the determination of the structure of carotene began to look feasible, Zechmeister having made a promising start. From 1931 onwards the successes of adsorption analysis have been so numerous that the method has become indispensable.

A monograph on the subject was produced a few years later and proved to be a model of its kind, and the need for an English translation was at once recognized by Mr. Bacharach in reviewing the first edition in NATURE (July 10, 1937). A second edition was soon called for (NATURE, April 8, 1939), and Mr. Bacharach has added to his many services to chemistry in producing this careful translation. If the English sometimes lacks the verve of the translators' own writings, it is meticulously accurate, apart from the title.

Chromatography, according to the dictionary, is the *description of colours*, and the word was used in 1731 and 1835 in the titles of treatises on colours and pigments. The title of Zechmeister and Cholnoky's volume, namely "The Chromatographic Adsorption Method", is perhaps a little cumbrous in English.

The book contains a full account of the many technical developments which have resulted from the wider application of the method and of the achievements to be credited to them. Each topic is dealt with in its proper setting, so that many fields of research are reviewed in an interesting way which adds greatly to the value of the work.

To carry out with one's hands a complete and flawless chromatographic separation is a difficult but satisfying achievement, and simple exercises can be devised which give students enjoyment and training in craftsmanship. Many perfectly developed chromatograms of leaf pigments were produced under the direction of Baly and Heilbron in 1922-23, and to-day the photographs recording those experiments tell their own story. A vast literature of research, however, lies in between, and it seems not unlikely that Tswett's method came into general use only when the time was ripe.

Zechmeister and Cholnoky in the preface to the second edition explain that they had intended to include a biography of Tswett, but they add that "trustworthy information about the active life of this pioneer has, however, not so far been available to us". It is to be hoped that circumstances will permit those who knew Tswett to provide a record of his life and work, for the debt we owe to him is great and increasing. R. A. MORTON.

Elementary Physics

For Medical, First Year University Science Students and General Use in Schools.
By Prof. G. Stead. Sixth edition. Pp. xiv+562. (London : J. and A. Churchill, Ltd., 1940.) 12*s*. 6*d*.

PROF. STEAD'S book is primarily intended for the use of medical students and first-year university students, though the author expresses the hope that it will be found useful for School Certificate and Higher School Certificate candidates. In a single book covering such a wide field, it is not possible to treat the various topics as fully as perhaps one would wish and it is intended that the book should be used in connexion with a course of lectures with practical demonstrations. So far as Higher School Certificate work is concerned, this plan would be necessary. In the main, the book is up to date ; it seems a pity, however, that the more convincing method of using actual beams of light instead of pins in verifying laws in connexion with mirrors and lenses is not advocated. Also in a modern text-book surely less space should be devoted to the 'shadow' and 'grease spot' photometers, and more attention paid to modern instruments to bring the subject into line with modern practice.

The book is excellent in its way ; the diagrams are good and plentiful, and so far as space will allow the facts are presented clearly. It is, however, definitely a book for specific examination purposes, and apart from the stress made on medical applications, there is little attempt to correlate physical principles with everyday life ; probably for a single text-book too much has been attempted.

First Course in Theory of Numbers

By Prof. Harry N. Wright. Pp. vii +108. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 12*s*. net.

WHAT is the minimum knowledge of the theory of numbers that every mathematician should have ? The question must be elaborated. "Should", because ignorance is likely to detract from his efficiency whatever his own field may be ? Then he needs very little : the Euclidean algorithm and its direct consequence in the existence of identities of the form $ax - by = 1$; nothing at all about continued fractions, if the current fashion is a safe guide. "Should", in order to discover whether the subject makes any appeal to him ? Then add the elements of linear congruence, and a few classical theorems such as Fermat's. "Should", if he cares about being well-read in pure mathematics generally ? Then include simple continued fractions and the law of quadratic reciprocity.

Prof. Wright's book is a college course, appropriate in scope to the last class of reader, and with a satisfying unity, but rather expensive regarded as a substitute for four or five chapters of a text-book on algebra. The author has succeeded in infusing his enjoyment of the subject into a sound exposition. Confusion on the eastern side of the Atlantic is almost inevitable : this bookwright is not Prof. Hardy's collaborator in the same domain. E. H. N.

Calculations of Quantitative Analysis

By Prof. Carl J. Engelder. Pp. viii+174. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1939.) 12*s*. net.

THIS book, which is up to the English Intermediate Degree standard, gives a straightforward account of the theory underlying the calculations in quantitative analysis. The text is illustrated by a large number of worked-out problems, and each of the fifteen chapters concludes with original calculations for the student to work out for himself. Answers are only given to the odd-numbered problems, since these are intended for home-work, but those to the even-numbered problems can be obtained on application to the publisher.

The book is divided into four parts. The first part is devoted to general considerations such as the use of logarithms and the methods of designating the strength of solutions. The calculations in volumetric work are considered in the second part, and this includes the calculation of values in acid-base titrations. Part 3 is devoted to gravimetric analysis and includes a chapter on the solubility product principle. The fourth part deals briefly with the application of analytical data, as for example, the calculation of atomic weights.

The subject-matter in these four parts is generally sound and up to date, though the statement (p. 58) that salts of the sodium chloride type are ionized 80 per cent or more in 0·1 *N* solutions is not in keeping with modern theory. Similarly, it is confusing to find a calculation (p. 129) on the hydrogen ion concentration of a mixture of 0·5 *M* acetic acid and 0·3 *M* sodium acetate in which an allowance is made for the 78 per cent ionization of the salt.

At the end of the book, in addition to an index and logarithm tables, there is a large number of tables of physical properties, such as the specific gravities of acids and alkalis and the solubility of salts, which should prove very useful in the laboratory. A. C. C.

Organic Chemistry

By Dr. F. Sherwood Taylor. Third edition. Pp. xi+588. (London : William Heinemann, Ltd., 1940.) 10*s*. 6*d*.

DR. TAYLOR has established a reputation as a writer both of text-books and more popular works on science, and he is thus able to put a little more feeling into his descriptive organic chemistry than is customary—some of the compounds seem to have life and uses and to be something more than colourless crystalline compounds having the formulæ indicated. It is a task to get all organic chemistry into 500 pages; the same number of specialized monographs would scarcely do it. Yet something has to be provided to enable the student to beat the examiner. The book has a biological bias as is to-day proper : it contains the essential significant facts about the commoner organic compounds, the presentation is clear and we have no hesitation in recommending it as in many ways superior to its competitors.

E. F. A.

THE ORIGIN OF MAN

By Dr. R. Broom, F.R.S.
Transvaal Museum, Pretoria

WHEN, in 1924, Dart of Johannesburg discovered a type of fossil anthropoid more man-like than the chimpanzee or gorilla, a new chapter was opened in the early history of man. Dart named his fossil form *Australopithecus africanus*, and he regarded it as somewhat intermediate between the living anthropoids and man, and probably near to the anthropoid from which man arose. The first account of the discovery was given in NATURE of February 7, 1925.

The skull which Dart had discovered was unfortunately that of a young child-ape of about five years, and a few of the rather striking human resemblances were no doubt due to the immaturity of the specimen; and the majority of men of science were not inclined to accept Dart's opinion. They regarded the animal as closely allied to the chimpanzee, though with a few human characteristics apparently acquired by a parallel development. One authority considered that the skull is only "the distorted skull of a chimpanzee".

A few of us have consistently maintained since 1925 that Australopithecus is not only not a chimpanzee, but also that it is not at all closely allied to the chimpanzee, and that it has many characters that prove it to be near to the human ancestor.

In 1929 Dart removed the lower jaw from the upper and revealed for the first time the occlusal surfaces of the crowns of the milk molars. The side view of these teeth had shown that they were markedly different from those of the chimpanzee and gorilla, and were very like those of man. The occlusal surfaces now fully confirmed this view. They showed that Australopithecus cannot be nearly allied to any of the living anthropoids.

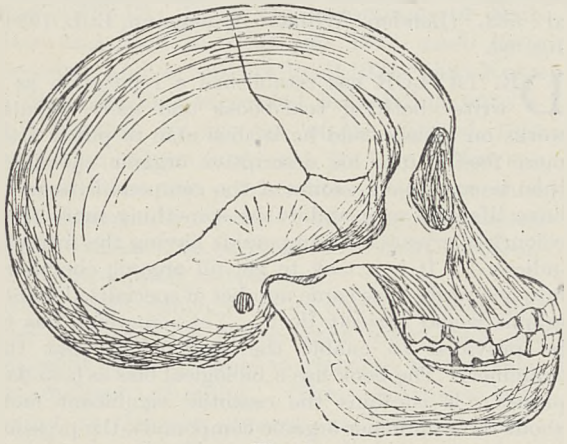

Fig. 1.
SIDE VIEW OF SKULL OF *Australopithecus africanus* DART. ½ NATURAL SIZE.

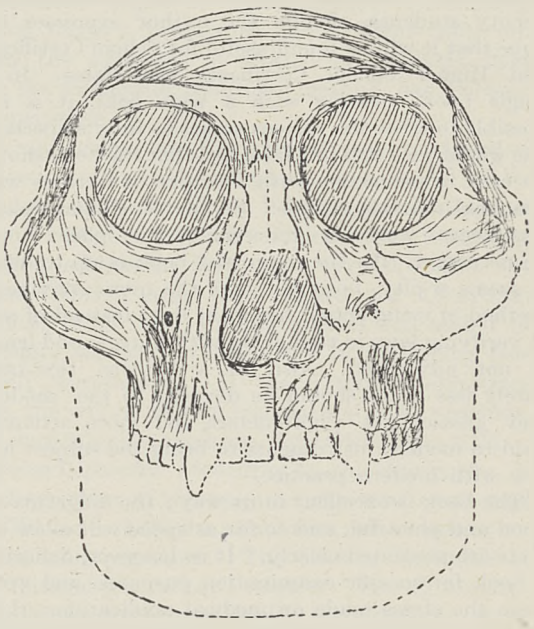

Fig. 2.
FRONT VIEW OF FACE OF *Plesianthropus transvaalensis* (BROOM). ½ NATURAL SIZE. THE PARTS SHADED ARE KNOWN IN THE TYPE. THE MANDIBLE IS UNKNOWN IN THE TYPE, BUT CONSIDERABLE PORTIONS ARE KNOWN IN OTHER SPECIMENS.

The first upper milk molars in the gorilla and chimpanzee have two main cusps. In man there are three; and Australopithecus agrees with man. The first lower milk molar in the gorilla is a flattened tooth with one large pointed median cusp and indications of small anterior and posterior cusps. In fact, it is not unlike the premolars of the dog. In man the first lower milk molar is entirely different. It is a molariform tooth with four well-marked cusps. In Australopithecus the tooth agrees closely with that of man. In the chimpanzee the tooth is like that of the gorilla with some rudiments of the ancestral condition. By no possibility can man have been derived from an anthropoid with degenerate and specialized teeth like those of the gorilla or chimpanzee. The four cusps which we find in man and Australopithecus are manifestly the four cusps found in the milk molars of the cercopithecids, such as the baboon. Man must have come from an anthropoid which still retained the cercopithecid type of

milk molars; and must have had a remote cercopithecid ancestor.

We need not here discuss the brain of Australopithecus. Dart and Elliot Smith considered that it showed some strikingly human characters; others thought the case not proved. Dart even went so far as to maintain that the structure of the brain showed that it was a bipedal animal, like man.

As Dart's type was only the skull of a young child-ape, the world remained unconvinced, and wanted an adult skull. So in 1936 I set about looking for one, and in a few weeks was successful; and not only got one, but parts of three others with many isolated teeth. Then in 1938 I got a good skull of what I consider to be a third new genus of man-like ape.

For many months I have been working at the Sterkfontein type skull, and have now completed a reconstruction of it; and it seems but right to reveal at the earliest possible moment how this anthropoid looked. I shall not here discuss at length my reasons for regarding this Sterkfontein ape as belonging to a distinct genus from Australopithecus. Manifestly the two forms belong to very different geological ages. The Sterkfontein, which I call the *Plesianthropus transvaalensis*, is probably of Middle Pleistocene age. The Taungs ape is almost certainly very much older. Probably it belongs to the Lower Pleistocene, but just possibly it may be Upper Pliocene.

Plesianthropus, as will be seen from the illustrations, has a skull somewhat like that of the chimpanzee in size, but differing greatly in many characters. Though the skull is that of a male, the canine, though fairly large, is unlike that of the chimpanzee, and there is practically no diastema between it and the second incisor. The cheeks are broad and more like those of the gorilla and orang than those of the chimpanzee. The nasal bones are only partly known, but from the upper parts of the maxillæ we can be confident that the nose must have been more man-like than ape-like.

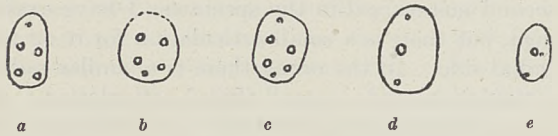

Fig. 3.

DIAGRAMS OF THE CUSPS IN THE FIRST LEFT LOWER MILK MOLARS IN VARIOUS PRIMATES. *a*, BABOON; *b*, AUSTRALOPITHECUS; *c*, BUSHMAN CHILD; *d*, GORILLA; *e*, CHIMPANZEE (ALL NATURAL SIZE).

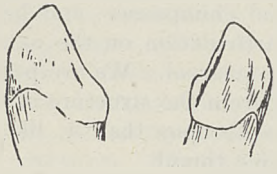

Fig. 4.

INNER SIDES OF LOWER CANINES OF ANTHROPOIDS (NATURAL SIZE). *a*, CANINE FROM YUNNAN, REGARDED BY WEIDENREICH AS CANINE OF AN ORANG, BUT BY THE WRITER AS MORE PROBABLY AUSTRALOPITHECINE CANINE AND POSSIBLY THE CANINE OF GIGANTOPITHECUS (FROM CAST); *b*, CANINE OF MALE *Plesianthropus transvaalensis*.

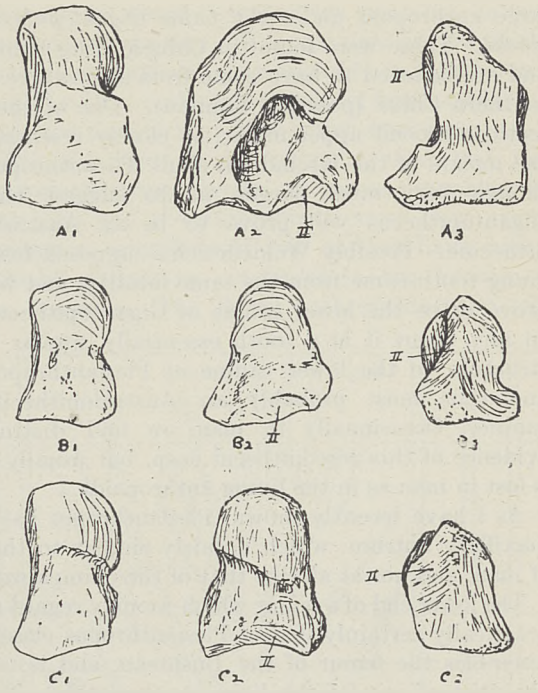

Fig. 5.

THE OS CAPITATUM (OR OS MAGNUM) OF THE CHIMPANZEE *A*1, *A*2 AND *A*3; OF THE STERKFONTEIN APE *B*1, *B*2 AND *B*3; AND OF THE BUSHMAN *C*1, *C*2 AND *C*3. DORSAL, RADIAL AND DISTAL SIDES. THE ARTICULAR SURFACES INDICATED BY II ARE THOSE FOR THE IIND METACARPALS.

The teeth, though a little larger than those of man, are almost typically human, and not very like those of either the chimpanzee or gorilla (Figs. 3 and 4).

The most interesting tooth in Plesianthropus is the lower canine. It is of a type almost unique. It differs markedly from the lower canines of the living anthropoids, and there are no known fossil canines at all like it, except one. On the posterior border of the tooth there is a very distinct small cusp with, in front of it on the outer side, a moderately deep vertical groove, and on the inner side in front of it a very deep groove. This little cusp is a typical cercopithecid character lost in all known anthropoids, except one. Weidenreich figures a lower canine from a cave at Yunnan which he refers to a "fossil orang". In my opinion this is unlikely to be the canine of an orang.

Von Königswald has described some teeth of a

large anthropoid under the name *Gigantopithecus blacki*. These were found in Chinese drug stores, and are believed to have come from somewhere in southern China (possibly Yunnan). One of these teeth, a second upper molar, so closely resembles the molars of the Kromdraai skull, Paranthropus, though very much larger, as to suggest that Gigantopithecus will prove to be an Australopithecine. Possibly Weidenreich's supposed fossil orang tooth came from the same locality, and will prove to be the lower canine of Gigantopithecus. In any event it is a tooth essentially similar in structure to the lower canine of Plesianthropus, and thus most probably an Australopithecine canine. Occasionally in man we find distinct evidence of this cercopithecid cusp, but usually it is lost in man as in the living anthropoids.

As I have recently shown, Plesianthropus has a maxillary antrum, which is fairly similar to that of man, and not at all like that of the chimpanzee.

The lower end of a femur which we may regard as practically certainly that of Plesianthropus closely resembles the femur of the Bushman, and is not like that of any of the living anthropoids. The only known wrist bone is very similar to that of a Bushwoman and differs greatly from that of the chimpanzee. I recently gave a figure of this os magnum or os capitatum, and for comparison the corresponding bones in some other Primates. Unfortunately, the supposed chimpanzee bone figured is really that of the orang. I therefore give a few other figures to avoid any possible confusion. Curiously enough the chimpanzee bone is less like that of Plesianthropus than is that of the orang,

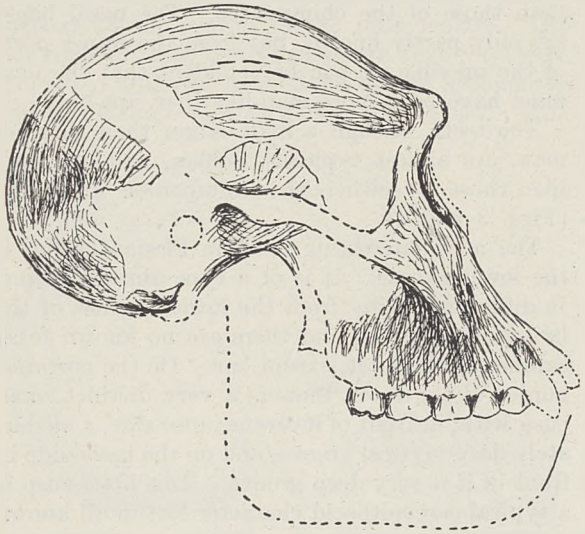

Fig. 6.

SIDE VIEW OF SKULL OF *Plesianthropus transvaalensis* (BROOM). APPROX. 3/7 NAT. SIZE. THE PARTS SHADED ARE ALL KNOWN IN THE TYPE SPECIMEN. TWO OF THE TEETH ARE DRAWN FROM THOSE OF THE LEFT SIDE. THE SKULL IS THAT OF A MALE.

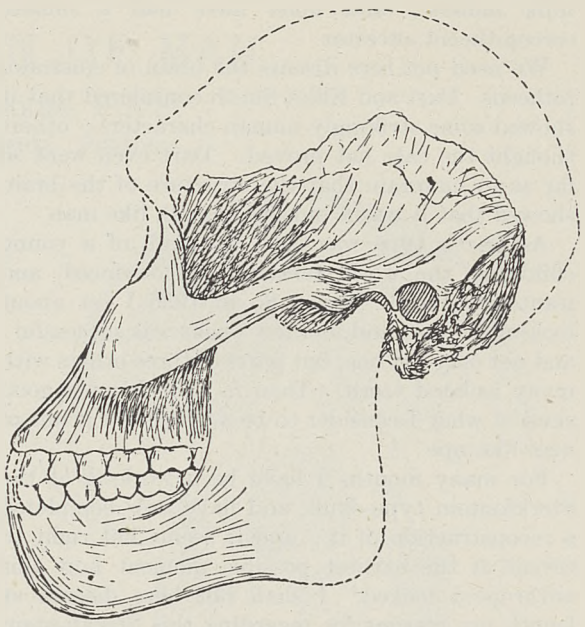

Fig. 7.

SIDE VIEW OF THE KROMDRAAI SKULL, *Paranthropus robustus* (BROOM). APPROX. 3/7 NATURAL SIZE. THE SKULL IS PROBABLY THAT OF A MALE.

and it is distinctly more baboon-like, though it has no os centrale (see Fig. 5).

In neither the orang, the gorilla nor the chimpanzee is the os capitatum like that in man. One very important difference is that in man the distal end of the bone gives a large articulation to the second metacarpal. In the chimpanzee and gorilla the distal end gives no articulation to the second metacarpal in the specimens I have examined, but there is a small articulation for it on the radial side. In the orang there is a similar radial articulation and a small distal articulation. In Plesianthropus the condition is essentially as in man, with a large articulation on the distal end for the second metacarpal. Probably the large articulation for the second metacarpal in man is due to the greater development of the metacarpal in connexion with the well-developed thumb. In the orang the thumb is better developed than in the gorilla and chimpanzee, and here there is a small distal articulation on the os capitatum for the second metacarpal. We are perhaps justified in concluding from the structure of the os capitatum in Plesianthropus that it, like man, had a useful opposable thumb.

The Kromdraai ape, *Paranthropus robustus*, is a third type of South African Australopithecid. It differs in many characters from Plesianthropus. It has a smaller canine and a very differently shaped face, and the premolars are much larger and differently shaped. It is also of a different geological age. The baboons associated with it

are of different species from those at Sterkfontein, and so are the species of Procavia. Though probably of Middle Pleistocene age, it may be many thousands of years older than Plesianthropus.

The skull gives us the perfect glenoid cavity which is almost typically human in structure, and quite unlike that of either the chimpanzee or the gorilla. The brain is probably considerably larger than that of Plesianthropus. Though only some fragments of the mandible of Plesianthropus are known, we have a good lower jaw of Paranthropus. Its teeth are almost typically human, but the premolars are very large ; while the canines are remarkably small.

We have the distal end of the humerus and the proximal end of the ulna of Paranthropus. These were found with the type skull, and there cannot be the slightest doubt that they belong to the same individual. They are almost typically human in structure, and very unlike those of the living anthropoids.

The South African caves have shown us that there lived in Pleistocene times various anthropoids which in many characters were much nearer to man than the living anthropoids. They had larger brains, and almost the human type of teeth, and there is considerable reason to believe they were mainly bipedal. They certainly were not arboreal, and they probably hunted in packs. There is reason to believe that they used sticks or stones for digging and as weapons. We can scarcely doubt that, though not yet human, they were nearly related to man.

Man was undoubtedly on the earth in Upper Pliocene times and must thus have been living in Europe and Asia when the known Australopithecines were inhabiting South Africa. Though it is thus improbable that any of the known South African Australopithecines can have been the ancestors of man, the discovery of these very manlike anthropoids shows us that there once lived a group of anthropoids so near to man in structure that we seem forced to believe that man has come from a Pliocene Australopithecine.

Though the gorilla is well removed from man's ancestor, he must be more nearly related to man than is the chimpanzee. Man and Australopithecus have retained a number of cercopithecid characters lost in the living anthropoids, but manifestly the gorilla and chimpanzee must have had cercopithecid ancestors. The cercopithecids have very marked ischial callosities. These are retained in the gibbons, and are occasionally well marked in the chimpanzee, but are lost in the orang, the gorilla and man.

Some years ago I argued that man must have sprung from a heavily built anthropoid such as the gorilla, which had to use its hallux for support, otherwise he would have lost his great toe, as has the kangaroo to-day. If I am right in assuming that Gigantopithecus was probably an Australopithecid we have perhaps in this giant form an anthropoid very near to that from which man arose.

The structure of the teeth in man and the Australopithecines seems to prove conclusively that man and the anthropoids must have come through a cercopithecid line as they have cercopithecid characters not found in the lemurs or the tarsioids. The living anthropoids have lost

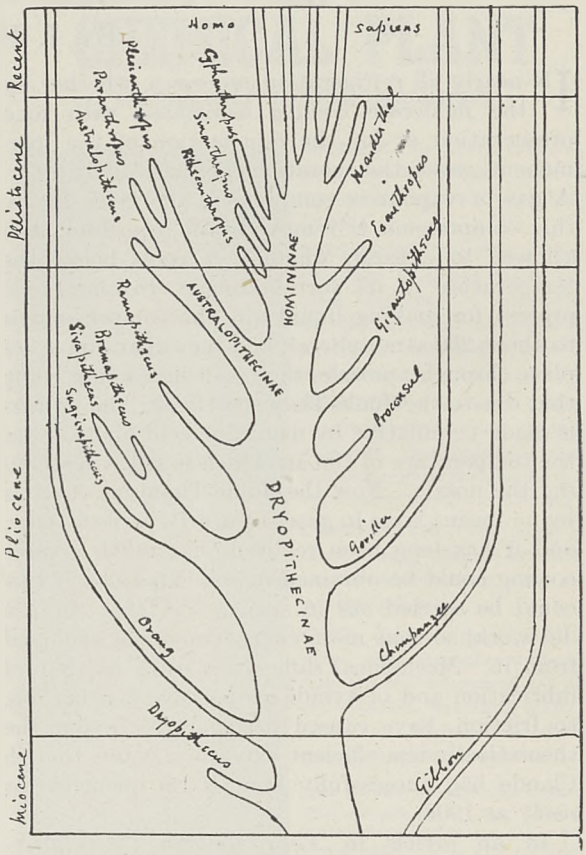

Fig. 8.

PHYLOGENETIC RELATIONSHIPS OF MAN AND THE HIGHER ANTHROPOIDS.

many of the cercopithecid tooth characters, but the orang retains sufficient to leave no doubt of the cercopithecid ancestry.

I think there can be no reasonable doubt that man arose in Middle or more probably Upper Pliocene times from a large Australopithecine ape. The known Australopithecines are near relatives of this ancestor. The living anthropoids are much more remote relatives.

Though there are many who object to genealogical trees—and certainly some of those that have been published have been unsatisfactory—someone must be correct ; and the one I here give may

with further knowledge have to be modified, but I think it cannot be very far from the truth.

In the tree I give, attention may be directed to the placing of Ramapithecus nearer to the base of the human stem than the other Siwalik types, and to the placing of Proconsul higher up than is usually done. Hopwood regards Proconsul as a Lower Miocene form "related to *Dryopithecus* and ancestral to the chimpanzee". I have only seen the cast, but incline to place it nearer to the gorilla, and appreciably higher. Possibly the supposed Miocene age is wrong.

The reasons for the various conclusions to which I have come will be given at length in the long paper I have in hand on the South African Pleistocene Anthropoids.

A NEW PROCESS FOR LIQUEFYING AIR

By J. H. Awbery

IN nearly all refrigeration processes, whether for the moderate cooling associated with food preservation or for the liquefaction of the 'permanent' gases, the operations are basically similar. A gas or vapour is compressed, the heat due to this compression is removed, and the fluid then allowed to expand, whereby it cools below the temperature of its surroundings. In the Linde process for making liquid air, the compression is to about 200 atmospheres, and the expansion takes place through a nozzle, the resulting cooling being that due to the Joule-Thomson effect ; the process is made cumulative by using the cold air to lower the temperature of the air which is still approaching the nozzle. Now the Joule-Thomson effect is by no means large in gases so nearly perfect as air, and it has long been realized that much greater cooling could be obtained in the expansion if this could be carried out in such a way that the gas did work, so that more energy would be removed from it. Mechanical difficulties, such as that of lubrication and of avoiding excessive heating due to friction, have caused designers to favour the theoretically less efficient expansion valve, though Claude had successfully applied the principle as early as 1906.

In an article in *Voks Bulletin* (November–December, 1940), Prof. P. Kapitza gives a brief description of an installation which has now been set up at the Institute of Physical Problems of the Academy of Sciences of the U.S.S.R., in which the expanding air does work by driving a turbine. The increased temperature-fall, as compared with free expansion through a nozzle, is so great that the initial compression need only be of the order of 5 atmospheres, instead of the 200 atmospheres necessary in Linde's process.

The main difficulty to be overcome was the design of the turbine itself, which is quite inefficient if the axial-flow impulse turbine used with steam is taken as a model. Owing to the low temperature, the air flowing through the turbine has a density five times that of steam at 250° C., so that there is a considerable centrifugal force as the fluid whirls around, and this must be taken into account, just as it is in a water turbine.

The present apparatus, which will be followed by larger ones, has a piston compressor working at 400 r.p.m., taking 50–80 kw. of electrical energy and delivering nearly 600 kgm. of air per hour at about 7 atmospheres. The compressed air then passes a water cooler and through the regenerator (cooled by previously treated air) to the turbine. The latter works at 40,000 r.p.m. and yields 4 kwh. of mechanical energy. The pressure drop is 4 to 1, and the cooling is such that air entering at — 158° C. emerges at — 187° C. (the boiling point of oxygen), implying the extraction of 3,700 calories per hour. The efficiency is thus 0·79–0·83. The regenerators also offer some novel features. There are two of them, used intermittently for about 26 sec. each, the change-over being effected automatically. They are filled with flat ribbon, 0·1 mm. thick and 50 mm. wide, with nodules.

From the turbine, the main air-stream is passed through the inner tubes of a condenser, only a small by-passed stream flowing through the outer tubes and being liquefied therein. The overall efficiency of the apparatus is such that it gives 29–30 kgm. of liquid air per hour, at an energy cost of 1·7 kwh. per kgm. It is calculated that this can be reduced to 1·2 kwh. per kgm. by making use of the mechanical energy from the turbine and by more suitable valves and other equipment, so as to utilize the full seven atmospheres compression, instead of only four-sevenths of it. If so, the apparatus will have about the same efficiency as present high-pressure installations.

It is even hoped that by working on a much larger scale, where heat losses are relatively smaller, the efficiency may rise to 1·1 or even 1·0 kwh. per kgm. of liquid air. In any event, as a laboratory installation, the outfit has many advantages, noteworthy among them being the short starting period (20 minutes or less) and the small dimensions, due to absence of decarbonizers, scrubbers, desiccators and other auxiliary gear.

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UNIVERSITY OF EDINBURGH

THE ACADEMIC YEAR begins about the middle of October and ends early in July.

The University embraces SIX FACULTIES, viz.: ARTS, SCIENCE, DIVINITY, LAW, MEDICINE AND SURGERY, AND MUSIC, in all of which degrees are conferred. There are many different avenues to the Degree of M.A. (Honours and Ordinary) and the wide scope of the Arts Curriculum permits of the combination of Arts, Science, Medical, Law or Special Studies. THE HIGHER DEGREES OF D.Litt., D.Sc., and Ph.D. are conferred and also the Degree of BACHELOR OF EDUCATION (B.Ed.) and BACHELOR OF COMMERCE (B.Com.), DIPLOMAS IN EDUCATION, in ACTUARIAL MATHEMATICS, in SOCIAL STUDY, and in ENGLISH LANGUAGE are granted. Degrees in Science (B.Sc. and D.Sc.) may be taken in PURE SCIENCE, ENGINEERING, AGRICULTURE, VETERINARY SCIENCE, FORESTRY, MINING, and in TECHNICAL CHEMISTRY. There are also DIPLOMAS IN TECHNICAL CHEMISTRY and in AGRICULTURE. The Degree of Bachelor of Divinity (B.D.) is conferred and also the DEGREES OF BACHELOR OF LAWS (LL.B.) and BACHELOR OF LAW (B.L.). In Medicine ample facilities are afforded for Clinical Instruction in various Hospitals in the City, and the following degrees are conferred: BACHELOR OF MEDICINE (M.B.), BACHELOR OF SURGERY (Ch.B.), DOCTOR OF MEDICINE (M.D.), and MASTER OF SURGERY (Ch.M.). The following DIPLOMAS are conferred in the FACULTY OF MEDICINE: DIPLOMA IN TROPICAL MEDICINE AND HYGIENE in PUBLIC HEALTH, in PSYCHIATRY, in RADIOLOGY and in TROPICAL VETERINARY MEDICINE. In the FACULTY OF MUSIC the Degrees of Mus. Bac. and Mus. Doc. are conferred.

The University Staff consists of 63 Professors, over 150 Readers and Lecturers, and 120 Assistants and Demonstrators. Facilities are afforded for research in scientific and other subjects.

Further information regarding Matriculation, Scholarships, etc., may be obtained from the Secretary.

W. A. Fleming,
Secretary to the University.

UNIVERSITY COLLEGE OF SWANSEA

(A Constituent College of the University of Wales)

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS

Metallurgy

Professor: C. A. Edwards, D.Sc. (Manchester), F.R.S.
Assistant Professor: R. Higgins, Ph.D. (Glasgow).
Lecturer: R. Griffiths, M.Sc. (Wales).
Assistant Lecturer: T. B. Wilkinson, Ph.D., B.Eng. (Liverpool).

Engineering

Professor: Frederic Bacon, M.A. (Cantab.), A.M.Inst.C.E., M.I.Mech.E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. Isaacs, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. Fordham, Ph.D. (Lond.), A.M.Inst.C.E., M.I.Struct.E.
Lecturer: J. Selwyn Caswell, M.Sc. (Wales), A.M.I.Mech.E., A.M.Inst.C.E.
Assistant Lecturer: W. E. J. Farvis, B.Sc. (Bristol).

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Metallurgy or in Engineering. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The Manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (*a*) Metallurgy; (*b*) Metallurgical Engineering; (*c*) Civil Engineering; (*d*) Mechanical Engineering; (*e*) Electrical Engineering; and (2) for Diplomas of the College in (*a*) Metallurgy; (*b*) Civil Engineering; (*c*) Mechanical Engineering; (*d*) Electrical Engineering.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College classes provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in April, 1942.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW, Registrar.
Singleton Park,
Swansea.

UNIVERSITY OF LIVERPOOL

FACULTY OF ENGINEERING

Dean: PROFESSOR R. G. BATSON, M.Eng., A.K.C., M.Inst.C.E., M.I.Mech.E.

Prospectus and full particulars may be obtained on application to the Registrar of Courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers.

DERBY TECHNICAL COLLEGE

The Governors invite application for the post of Lecturer in Mathematics. Candidates should be Graduates. Application forms can be obtained from the undersigned and should be returned by July 12th. Salary according to Burnham Scale.

W. A. RICHARDSON,
Derby Technical College, Principal.
Normanton Road,
Derby.

KING'S COLLEGE of HOUSEHOLD and SOCIAL SCIENCE (UNIVERSITY OF LONDON)

c/o University College, Leicester

COURSE IN DIETETICS

It is proposed to resume the Course for the University of London Academic Postgraduate Diploma in Dietetics in October, 1941.

For particulars apply to the Secretary, at the above address.

COUNTY BOROUGH OF DONCASTER

TECHNICAL COLLEGE

Applications are invited for the post of Chief Laboratory Steward in the Science Departments of the college, to commence as soon as possible.

Applicants, who must be over 25 years of age, should be skilled in the laboratory arts and have had experience in the service works of laboratories concerned with Chemistry, Physics, Biology, Mining, and Engineering Science.

Letters of application, accompanied by copies of three recent testimonials and the names of two referees, should be sent immediately to the Chief Education Officer, Education Offices, Doncaster.

Education Offices,
Doncaster.

UNIVERSITY COLLEGE, LONDON

By the courtesy of University College, Wales, the Psychological Department of University College, London, has transferred its laboratory and library to Aberystwyth. Full courses are available for intermediate, degree, and diploma examinations and for higher degrees by research. A Psychological Clinic has been opened for demonstrating methods of studying difficult, evacuated, and raid-shocked children.

For further particulars apply:

E. L. TANNER,
University College, London (Gower Street, W.C.1). Secretary.

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THE SEARCH FOR ECONOMIC PLANTS*

By Sir Arthur W. Hill, K.C.M.G., F.R.S.
Director, Royal Botanic Gardens, Kew

THE search for plants yielding spices and the history of their cultivation and use, as well as the story of the transport of the spices, is a romance which includes accounts of geographical discovery, monopolies, economic warfare, annexations of territories, and all the vices of theft, envy, hatred and malice, and all uncharitableness enumerated by the Apostle St. Paul.

Perhaps the spice which should be put in the forefront is pepper (*Piper nigrum*), native of Malabar and of the forests of Travancore, a spice now too seldom seen or appreciated in its natural condition as black pepper corns, which was the staple article of trade between Europe and India for many ages. Most people to-day use white pepper, which is the small berry-like fruit or peppercorn, ground after its pericarp has been removed, thus depriving it of some of its pungency and best seasoning qualities.

Pepper was well known to Theophrastus in the fourth century, B.C., and to Dioscorides and Pliny, the former stating it to be a product of India. Its export from Barakė on the Malabar coast, near Calicut, is recorded in A.D. 64, and black pepper is one of the spices on which the Romans levied duty at Alexandria about A.D. 176. The first particulars we have, that it was a climbing plant "sticking close to high trees like a vine", occur in the writings of Cosmas Indicopleustes, a merchant and later a monk, who wrote about A.D. 540.

The wealth of Venice and Genoa largely depended on this spice, for tribute was levied in pepper, when money was scarce; it was often enacted that rents should be paid partly in pepper, and the Easterlings, according to the Statutes of Ethelred (A.D. 978–1016), coming in their ships to Billingsgate, had to pay at Christmas and Easter for the privilege of trading with London, a small tribute of cloth, five pairs of gloves, ten pounds of pepper and two barrels of vinegar. Now the only survival of this practice is the 'peppercorn rent', which signifies a merely nominal payment. The merchants who trafficked in spices in England were known as pepperers, and existed as a guild in the reign of Henry II and later were incorporated in the Grocers' Company.

Pepper, gums, myrrh, frankincense and cardamoms reached Europe mainly either by the Persian Gulf through Mesopotamia and Syria to the Levant or by the Red Sea and the Gulf of Suez and thence overland to Alexandria, while some consignments were conveyed by Arabian or Chinese traders to a port in southern Arabia and thence overland by the Frankincense route via Petra to Gaza and to Acre. From Alexandria or from the Levantine ports to which the spices had come overland they were shipped in the days of the Roman Empire to Rome, and later to Venice or Genoa, which cities for so many years held the monopoly of the traffic in spices.

During the Middle Ages the price of pepper was exorbitant. The high cost of pepper was one of the main inducements to the Portuguese to search for a sea passage to India, in order to break down the Venetian monopoly in this and other spices. Vasco da Gama anchored off Calicut in May 1498, and thus to pepper very largely, therefore, may be attributed the discovery of the Cape of Good Hope.

About the year 1500 the cultivation of pepper was taken up in the western islands of the Malayan Archipelago, especially in the islands of Rhio and Penang, and in Johore. The Dutch East Indies, Singapore, Penang, Ceylon, India and Indo-China are now the chief sources of supply.

The Venetians made every effort to retain the valuable traffic in their own hands, but in 1522, the first consignment of pepper reached Antwerp direct from India in a Portuguese ship, and the trade continued to be a monopoly of the Crown of Portugal until the eighteenth century. With the development of the all-sea route the overland traffic gradually came to an end. With regard to India, the century of Portuguese conquest of the west coast may be recalled, then their ousting by the Dutch, and finally, British dominion under the East India Company, and the efforts of the French and Danes to secure a share in the lucrative trade. Pepper thus was one of the principal economic products which has not only greatly enriched those who have held monopolies in its traffic, but has also incited geographical discovery, resulting in wars to secure possession of its native country.

Cloves, cinnamon, cassia, nutmegs and mace each have a history in which high enterprise, warfare, subterfuge and theft have all played their part.

Cloves are the dried flower buds of *Eugenia caryophyllata*, which is said to be native only in the five small islands of the Moluccas proper

* The substance of a lecture delivered before the Royal Geographical Society.

(Ternate, Tidore, Mutir, Machian and Bachina). The tree was introduced to Amboyna before the arrival of the Portuguese and is still cultivated there and in some of the neighbouring islands. Cloves are probably one of the oldest known of the spices, for it was customary for the Chinese Court officers, under the Han Dynasty, 266 B.C., to hold cloves in their mouth before addressing the Sovereign, to give their breath an agreeable odour. Nicolo Conti, a Venetian merchant, 1424–48, discovered the source of origin, previous writers having assumed that the places whence the spice was shipped, Ceylon, Java, or Malacca, were the homes of the plant. To the Portuguese however we owe our first accurate localization and description of the clove-tree, furnished by Pigafetta, the companion of Magellan, as he saw it in 1521.

For nearly a century the Portuguese were in control of the Spice Islands and had the principal share in the clove trade, until 1605, when the Dutch took possession of the Moluccas, and attempted to control the trade. They tried to restrict the tree to the Amboyna Islands—as they did with the nutmeg—and destroyed trees that might be growing elsewhere. Supplies however managed to reach England independently, though the Dutch monopoly was nearly complete until the latter end of the eighteenth century. Intrigue and theft apparently have played a very important part in the history of the clove in more recent times, for in 1770, the Governor of Mauritius and Bourbon, M. Poivre, procured living plants, both of cloves and nutmegs, and established them in those islands. The clove industry of Zanzibar and Pemba is due to an Arab from Zanzibar, who managed to obtain plants in Mauritius and took them about the end of the eighteenth century to his own island. Great Britain also took her share in what were probably illicit introductions of the spice plants, for, after Penang was founded in 1786 by Captain Light, the East India Company deputed Christopher Smith—one of the Kew collectors sent out by Sir Joseph Banks and George III—to visit the Moluccas and bring back spice plants (cloves and nutmegs) for cultivation.

The cultivation of cloves is now being extensively developed in Madagascar, which may prove a menace to the industry of Zanzibar and Pemba.

One of the present-day problems of economic plants relates to cloves, since the trees in Zanzibar are affected by a die-back disease, which demands careful research into ways of combating the malady and possibly of finding forms or varieties that may be resistant.

Nutmegs, *Myristica moschata*, are natives of the eastern islands of the Moluccas (Ceram, Banda) and of New Guinea. Nutmegs and mace, the crimson network arillus surrounding the nut, were imported into India at an early date by the Arabians and thus reached the West.

The home of the nutmeg was mentioned by Masudi about A.D. 918, and by the middle of the twelfth century nutmegs and mace were being imported to Aden, and duty on them was being levied at Acre about A.D. 1180. Ten years later they, with other aromatic products, were used in fumigating the streets of Rome at the coronation of the Emperor Henry VI. By the end of the twelfth century, nutmegs and mace were well known in Europe, but very costly, for about 1284, 1 lb. of mace cost 4*s*. 7*d*., the value then of three sheep or half as much as a cow. The Portuguese discovered the plant in Banda in 1572 and held the trade until they were driven out by the Dutch. The Dutch tried to restrict the trees to Banda and Amboyna by destroying the trees in all the other islands. In this however they appear to have been frustrated by pigeons, which swallowed the seeds and deposited them in neighbouring islands.

Great Britain occupied the Spice Islands during 1796–1802, and thanks to Christopher Smith's mission and the activities of Sir Stamford Raffles, nutmegs and cloves were introduced to Bencollen (Sumatra) and Penang. Plants were sent to Kew about that time and thence to St. Vincent and Grenada, where nutmegs now flourish.

Cinnamon (*Cinnamomum zeylanicum*), native of Ceylon, and cassia bark, the product of *Cinnamomum cassia* from southern China, are probably the earliest known of the spices. Frequent references occur to them in the Bible, and Theophrastus, Herodotus, Dioscorides, and other ancient writers refer to them as precious odoriferous substances. Cassia is mentioned in the earliest Chinese herbal, about the year 2700 B.C. To the Chinese may almost certainly be attributed the discovery of cinnamon in Ceylon, since they traded to Ceylon in very early times, and were no doubt familiar with the Chinese cassia-yielding species of Cinnamomum, which is very similar in appearance to the true cinnamon of Ceylon. An Arab writer, Kazwini, mentions cinnamon as a product of Ceylon in 1275, as do Ibn Batuta, the Muhammadan traveller, 1340, and Nicolo Conti, a hundred years later. The Portuguese discovered Ceylon after circumnavigating the Cape, and occupied the island on account of the cinnamon. Then the Dutch captured Ceylon, again because of cinnamon, about 1656, and established a monopoly in the spice, burning, as they did nutmegs, the stocks in Holland when the supply was greater than the demand. The English took Ceylon from the Dutch in 1796, and the East India Company held the monopoly in cinnamon until 1833.

(*To be continued.*)

OBITUARIES

Prof. F. Aveling

PROF. FRANCIS AVELING, professor of psychology in King's College, London, died on March 6, aged sixty-five.

The distinctive place in the development of British psychology which the late Prof. Aveling held, resulted from the rigorous training in philosophy to which he submitted himself before taking up his main work. Many others of his generation had reached psychology by the same route, but few have so succeeded in bringing their earlier discipline to bear fruitfully upon an empirical science. His study of the scholastic writers had given him a passion for precision and definiteness of thought, but never tempted him to forsake the experimental path for the *a priori*. His views were always as clear and hard in outline as one would expect from a student of St. Thomas, yet he was ready to modify them at any time when new evidence was presented.

Aveling was generous to a fault in his appreciation of the work of others. He could not believe that honest and persistent scientific effort could fail to reach at least partial truth, and in his later years some of his most interesting work lay in an attempt to evaluate the work of schools whose tenets were apparently opposed to those he held, believing it possible to show that their theories were not so much antagonistic as complementary to his own. He ascribed to controversial opponents his own obstinate integrity of mind, and was convinced that they could not have missed the mark completely. In the same spirit he always tried to relate his researches to those of others, believing that progress depended more on co-operation than on claims to originality. At the end of his life his views and sympathies (never narrow) were so broadening that one fears that his finest work remains undone.

His philosophical interests were probably responsible for the direction taken by his most important researches. His fine work on the "Consciousness of the Universal" was directed to the old problem of how the mind can achieve general thought, when all its process, as dated events, must be particular. This he approached in the light of the researches of the Würzburg school. After the interruption due to the War of 1914–18, in which he saw service, his work in this field was resumed by his pupils, who probably carried the study of the phenomenology of thinking as far as it is likely to go. From this he passed to volition, and an important series of studies were carried out in his laboratory. Here, too, his philosophical training is evident in his resolute facing of difficult theoretical problems, when he was driven to distinguish sharply conation from the decisive direction of effort exercised by the self. This work was summarized in "Personality and Will".

A little earlier he had published the " Psychological Approach to Reality," in which he applied the noegenetic principles of Spearman to the refutation of solipsism. But though his love of philosophy may have determined his own contributions to psychology it did not limit his activities. Only those who knew his laboratory well can properly appreciate Aveling's work. An enormous range of research was carried on there by his pupils, extending from elaborate experimental studies of perception to social psychology, each piece of work being designed to link on to other work in progress there or elsewhere. Much ingenious apparatus was designed and made in those cramped, inconvenient rooms. He popularized the tachogram method of experimentation on the psycho-galvanic reflex.

But the most lasting memory, and the truest, is of Aveling among his enthusiastic pupils, upon whom he bestowed so much affection, and so large a measure of his energy.

A. W. WOLTERS.

Mrs. H. H. Brindley

THE sudden and untimely death on April 3 of Mrs. H. H. Brindley has deprived us not only of an able entomologist but also of one of the most accomplished field ornithologists of her generation.

Maud Doria Haviland was a great-granddaughter of the famous Dr. John Haviland, professor of anatomy and then regius professor of physic at Cambridge from 1814 until 1851. She spent a large part of her early life in south-eastern Ireland, and it was here as a schoolgirl that the love of birds and wild animals developed. Although her outlook at first was that of the sportsman and field naturalist (she was a keen rider to hounds and a good shot), she was soon teaching herself vertebrate anatomy from text-books and taking every opportunity to practise dissection. Scientific publication began in 1913 with papers on ornithological subjects. In 1914 she went to Siberia as naturalist to a small anthropological expedition from Oxford, and this resulted in a delightful traveller-naturalist book "A Summer on the Yenesei" (1915). The war years 1914–18 were crowded with varied activities: residence at Cambridge, where she mastered the more technical aspects of biology with remarkable facility; driving a motor lorry over the rude tracks of the Bessarabian steppe, where she acted as chauffeur to a contingent of the Scottish Women's Hospital; and ambulance driving in the Paris-Soissons region for the French Red Cross. This period culminated in her election to a research fellowship at Newnham College in 1919, held until her marriage in 1922 to Mr. H. H. Brindley, fellow of St. John's College,

That Mrs. Brindley was a first-class field ornithologist her numerous papers show clearly. But she was also an entomologist of real ability. She published several valuable papers on the bionomics and post-embryonic development of various minute chalcid and cynipid hyperparasites of aphids, and she also produced excellent systematic work on the Mem-

bracidæ (Hemiptera) on which group she was an acknowledged authority.

In 1922 she visited the rain forests of the Essequibo and Demarara Rivers in British Guiana, and this expedition was the climax of her career as a field naturalist. During all her travels her outlook had been that of the ecologist, and the experience of tropical conditions enabled her in 1924 to give a memorable course of lectures to the Tripos class in zoology on certain aspects of animal ecology. This course resulted in a book entitled "Forest, Steppe and Tundra : Studies in Animal Environment" (1926), which is of permanent value as a series of essays linking the then somewhat youthful science of animal ecology with the outlook of the field naturalist. In this book there is much which deserves frequent re-reading, passages full of sound sense and keen insight. Her vivid and individual style expresses much of the woman herself—the energetic personality with its intense joy in the beauty of living things, combined in such a rare way with a critical appreciation of the scientific problems of the interaction of animals with their environment. But how can one describe adequately the charm of her company, the kind-hearted sincerity of her friendship and the irresistible delight and gaiety of her conversation ? She possessed a most whimsical humour, kindly yet penetrating, and her skill as a *raconteur* was incomparable. The sincere sympathy of a wide and varied circle of friends will go out to her husband and daughter. Her passing leaves a gap which cannot be filled.

W. H. THORPE.

Prof. H. Freundlich, For.Mem.R.S.

SUPPLEMENTING the notices referring to Prof. H. Freundlich, which appeared in NATURE of May 10, Prof. J. Traube writes :

I have been termed the founder of scientific *Kapillar-Chemie* (see, among other papers, Freundlich, "I. Traube, zum 70sten Geburtstag", *Kolloid-Zeitschrift*, **50**, 194 ; 1930). My papers are so nearly related to those of Freundlich, that I feel it a duty to write some words in memory of the man who has done such excellent work on colloid chemistry and especially on *Kapillar-Chemie*.

In view of Prof. Rideal's article, I must restrict myself to the special connexion between Freundlich's work and my own. Freundlich created the name "Traube's Rule". He directed special attention to this rule, and he was the first to recognize its importance.

More interesting is, perhaps, Freundlich's agreement with me with regard to the theory of solutions. I have at all times declared, in contradiction to van 't Hoff and Arrhenius, W. Ostwald and W. Nernst, that the well-known theory of van 't Hoff and Arrhenius is only partially right, that not the number of particles and ions only are to be considered, but especially the effect of the particles with regard to the surface tension, etc., and that the theory of solution is not so similar to the theory of gases as van 't Hoff supposed. I was very glad when I read in Freundlich's article written in honour of my seventieth birthday that Freundlich wrote, "es heisst nicht mehr 'entweder oder' sondern 'sowohl als auch' "; and when the editor of the journal, Wolfgang Ostwald, in deference to the memory of his father had suggested that certain changes in the article should be made, Freundlich replied, "In this case the changes would be made still more in favour of Professor Traube".

From a letter dated February 14, 1940, which Herbert Freundlich wrote to me from the United States, I was very glad to learn that he also had accepted my conception of the existence of different particles of liquids and gases above and below the critical temperature, which displaces the Andrews and van der Waals' theory of continuity. He recalled also that Prof. O. Mass in Montreal had acknowledged these ideas.

Prof. J. W. C. Gunn

THE death of Prof. John William Cormack Gunn at the age of fifty-two will prove a severe loss to the University of Cape Town, for he had occupied the chair of pharmacology since 1919, had done much to establish the medical school and in recent years had served as dean of the Faculty of Medicine.

An Orcadian by birth, Gunn took his medical degree at Edinburgh. He obtained several academic prizes, and after qualification devoted himself to teaching and research in pharmacology. He acted as assistant first at Edinburgh and then at University College, London. He served in the R.A.M.C. throughout the War of 1914–18 and on demobilization became lecturer at the Queen's University of Belfast. He left this post to take the chair at Cape Town in 1919. At Cape Town he carried out researches on the pharmacology of South African native plants and inspired research among many of his graduates.

As time went on, Gunn's energies were more and more absorbed in the administrative work connected with the rapidly growing School of Medicine. He showed a special aptitude for this work and was warden of the Medical Students' Residence, curator of the Wernher-Beit Medical Laboratories and dean of the Faculty of Medicine. Gunn's cheerful personality made him popular both as a teacher and as a colleague and his loss will be felt severely by a wide circle of friends both in South Africa and in Great Britain.

We offer our sympathy to his wife and two sons.

A. J. CLARK.

WE regret to announce the following deaths :

Sir David Wilson Barker, president during 1903–5 of the Royal Meteorological Society, on June 15, aged eighty-two.

Mr. C. W. Jeffries, director of the Royal Observatory, Hong-Kong, since 1932, on June 22.

Prof. Robert Robison, F.R.S., professor of biochemistry in the University of London and head of the Department of Biochemistry at the Lister Institute, on June 18, aged fifty-seven.

NEWS AND VIEWS

Prof. R. W. Wood, For. Mem. R.S.: Henry Draper Medallist

THE Henry Draper Medal of the National Academy of Sciences awarded to Prof. R. W. Wood, of Johns Hopkins University, at the 1940 annual meeting of the Academy, in recognition of his contributions to astronomical physics, was presented to him during the annual meeting in April last. Prof. Wood's contributions in the field of physics have been many and varied, and in the field of astrophysics three important researches, among many others, stand out especially. The first is Wood's pioneer work on resonance radiation and its applications to solar and stellar spectroscopy. A second is his development and skilful use of absorption screens of many types for astronomical and spectroscopic photography. Finally, and perhaps more important of all for the future of astrophysics, are the remarkable advances he has made in the construction of diffraction gratings. The use of the grating to produce a spectrum has been limited hitherto almost wholly to the sun and to bright sources in the physical laboratory ; by selection and shaping of the point of his ruling diamond, Wood succeeded in throwing as much as one half of the incident light into a chosen order of the spectrum. In addition, he was the first to achieve excellent results in ruling gratings on films of aluminium evaporated on glass. As a result, a modern Wood grating with high concentration of light is one of the most effective instruments of research in stellar spectroscopy. It has made possible the analysis of the spectra of the brighter stars on a large scale, has opened up the almost unexplored ultra-violet region of stellar spectra, and has already led to discoveries of interest regarding the constitution of the gases in interstellar space.

Sir C. V. Raman, F.R.S.: Franklin Medallist

DISSEMINATION of news in war-time is difficult and this somewhat belated intimation of the award of the Franklin Medal to Sir Venkata Raman is a result of the slowed-down process. It is good news, however, to hear that Raman has obtained this high honour "in recognition of his many brilliant contributions to physical science and of his leadership in the renaissance of scientific work and scientific education that has occurred in India during the last thirty years". Raman joins the very distinguished company of Franklin medallists, which includes Rutherford, Thomson, Marconi, Bragg, Planck, Arrhenius and T. W. Richards. Not only has Raman personally made important contributions to theoretical and experimental physical science, but he has also lit the torch of scientific research for a large number of his countrymen who are turning out much distinguished work.

Sir C. V. Raman has worked on many branches of physics—optics, acoustics, and more particularly on the light scattering, which, in his honour, is now almost universally referred to as Raman effect. His discovery of this effect in 1928 not only inspired its exploration by himself and his students, but also started physicists and physical chemists in every country of the world to investigate it. Through its investigation far-reaching conclusions regarding the structure of molecules can be adduced ; its utility and importance need not be stressed here, but are reflected in the large number of papers which have been, and continue to be, published on the subject. Raman has received many honours from learned societies and institutions and, in addition, a knighthood in 1929 and the Nobel Prize in physics in 1930. In congratulating Raman on his latest honour, we hope that he will continue for many years to exert his powerful influence in conducting and directing, with sustained distinction and success, the fundamental problems of physics in which he has so indelibly established his reputation.

Louis E. Levy Medal of the Franklin Institute

THE Committee on Science and the Arts of the Franklin Institute has announced that the Louis E. Levy Medal will this year be presented jointly to Profs. John M. Lessels and Charles W. MacGregor, both of whom are associate professors in the Department of Mechanical Engineering, Massachusetts Institute of Technology, for their paper entitled "Combined Stress Experiments on a Nickel-Chrome Molybdenum Steel". The Levy Medal is awarded annually "to the author of a paper of especial merit, published in the Journal of The Franklin Institute, preference being given to one describing the author's experimental and theoretical researches in a subject of fundamental importance".

John Moyes Lessels was born in Dunfermline, Scotland, on February 5, 1888. He was educated at Herriot Watt College and the University of Glasgow. During 1920–31, he was manager of the mechanical division of the research laboratories of the Westinghouse Electric and Manufacturing Company at East Pittsburg, and afterwards he was engineering manager of the South Philadelphia works. Since 1936 he has been associate professor of mechanical engineering at the Massachusetts Institute of Technology. He is technical editor of the *Journal of Applied Mechanics*.

Charles Winters MacGregor was born in Dayton, Ohio, on May 25, 1908. He attended the Universities of Michigan and Pittsburg, and during 1929–34 he was a research engineer with the Westinghouse Electric and Manufacturing Company at East Pittsburg. In 1934 he went to the Massachusetts Institute of Technology as instructor in mechanical engineering, and was appointed assistant professor in 1937.

Invalids and 'Fortified' Flour

THE Medical Research Council has issued a statement dealing with a suggestion that invalids may be harmfully affected by the consumption of bread 'fortified' with calcium. The need for this supplement is brought about in two main ways: first, the war-time diet in Great Britain tends to be deficient in available calcium, especially since restrictions have been imposed upon the sale of milk and eggs; secondly, the high content of cereal foods in the diet increases the amount of calcium it is necessary to ingest, partly because most cereals are deficient in calcium but also because the phytic acid in cereals often prevents the body from making use of the calcium they contain. The Ministry of Food has asked the Food Rationing (Special Diets) Advisory Committee whether the addition of small supplements of calcium salts to flour would be in any way deleterious to invalids. In reply, the Food Rationing (Special Diets) Advisory Committee has expressed the opinion that "there is neither medical nor scientific evidence that the consumption of bread made from flour fortified by the addition of appropriate quantities of calcium salts is harmful to patients suffering from any type of disease". This opinion was based on the following considerations.

It has been proposed by the Accessory Food Factors Committee of the Lister Institute and of the Medical Research Council that 14 oz. of calcium carbonate be added to each 280 lb. of 85 per cent extracted flour and 7 oz. of calcium carbonate to each 280 lb. of white flour. Expressing these quantities in other terms, it can be said that 1 lb. of the 'fortified' 85 per cent extracted flour and 2 lb. of the 'fortified' white flour contain slightly less calcium that 1 pint of fresh milk. There can therefore be no objection to the use of this fortified flour on the grounds that it will result in the consumption by invalids of harmful amounts of calcium. It has been suggested, however, that it might have a deleterious effect upon certain invalids because the calcium added to it is in a form—calcium carbonate—different from that which exists naturally in food. This criticism appears to be ill-founded. There is direct evidence obtained on human beings that the calcium of calcium carbonate is as available to the body as that of calcium phosphate. In an easily assimilable food, such as milk, calcium is in the form of a combination with a phosphoric acid, a common normal component of animal tissues; in calcium carbonate, calcium is also present as the salt of an acid of widespread occurrence in living tissues. In both cases, the calcium is split off from the acid during the process of digestion, and is absorbed into the body in the same form in each case.

Effect of Cooking on Vitamins

VITAMINS are lost or destroyed in the preparation and cooking of greenstuffs by many of the methods now in common use. Some generalizations which summarize our knowledge of the behaviour in greenstuffs of the vitamins most likely to be affected in the course of preparing green vegetables for the table have been issued by the Accessory Food Factors Committee of the Medical Research Council (London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1). Some simple rules based on these generalizations are given and cooking methods for greenstuff are recommended. Fat-soluble vitamin A is unlikely to suffer damage; water-soluble vitamins B and C are the most likely to be lost in preparation and cooking for various reasons stated. Twelve practical rules for the conservation of vitamins in the preparation and cooking of green vegetables are also given, together with methods recommended which result in the least loss of vitamin C.

War Food Production Advisory Bulletins

THE Welsh Plant Breeding Station, Aberystwyth, has issued two further War Food Production Advisory Bulletins, No. 2, "Ley Farming" by Sir George Stapledon, and No. 3, "Herbage Seed Production" by G. Evans (price 1*s*. each). These publications are complementary one to the other, the first being an extension of the first bulletin of the series, while the second shows the farmer how he can raise the necessary seeds himself. After a general description of the nature of ley farming and how it differs from the permanent grass or the grass-arable systems, six methods of dealing with permanent grass are suggested which show how the change over to ley-farming can be effected from all grades of land. Care is taken to indicate where manures, particularly phosphates, can be most profitably applied. As regards seed production, the directions are based on the author's experiences in inspecting farms and conducting experiments in various parts of Great Britain, and there seems no reason why more farmers should not successfully raise their own seed than have done so in the past. A full knowledge of the recent history of the fields and adequate provision for their isolation are two essentials for the production of pure strains; climate and soil are also important, the former especially in the case of the clovers, while grasses make larger demands on the soil. Practical recommendations are given as regards sowing, manuring, times of harvesting, threshing, cleaning and storing, together with the yields likely to be obtained. The bulletin concludes with a list of the herbage strains bred by the station at Aberystwyth and a description of their special characteristics.

Town and Country Planning

THE forty-second annual report of the Town and Country Planning Association refers to a memorandum on "Town Planning in Relation to the Present Emergency and After-War Reconstruction" submitted to the Prime Minister last autumn, as well as to opportunities which Sir Montague Barlow, Prof. P. Abercrombie, Dr. W. A. Robson and other members have had of putting before Lord Reith and Mr. Arthur Greenwood the policy of national planning, decentralization, re-development and construction of new towns for which the Association stands. The

agreed findings of the report of the Royal Commission on the Geographical Distribution of the Industrial Population are substantially consistent with evidence given before the Commission by the Association and have proved of the utmost value as a basis for national policy. The Council is considering what forms of activity are practicable in present circumstances to use the new opportunities. The formation of groups, in as many towns as possible, which will undertake research and education in the local application of a national planning policy, is desirable. There is a great demand from men in the services and civilian groups for well-informed talks and booklets on future planning. Much also needs to be done to develop sound policy and technical knowledge among members of local authorities and their staffs. The report also directs attention to the change in name of the Association from "The Garden Cities and Town Planning Association", and includes a short statement of town–country planning principles, adopted by the Council in January 1941, acceptance of which by the Government and Parliament is urged.

These suggestions include the establishment of a Ministry, advised by a National Planning Council, to guide future development and re-development, and the future grouping of industry and population, to secure the best use of the land and to conserve the national resources in the general interest. The distinction between town and county should be maintained in all development, and sporadic building in rural areas discouraged. In particular, good food-growing land, places of special landscape beauty, and areas suitable for national parks or coastal reservations should be protected from ordinary building development. Good design and lay-out of buildings and roads as well as sound construction should be an object of policy. In rebuilding urban areas, the density of residential districts should be limited to provide sufficient open space, including reasonable garden space, and wide country belts should be reserved around all cities and towns. New developments required by industrial changes, decentralization from congested areas, or by the growth of towns up to their planned limits should be directed to other towns or to new towns carefully sited and planned. The Ministry charged with national planning should have power to prevent, except under licence, the settlement of new industrial undertakings in overgrown or congested towns and in undeveloped rural areas, and to offer inducements to industry to settle in suitably selected places. The inadequate provisions for compensation and betterment under the Town and Country Planning Act should be replaced by new legislation based on expert consideration before the conclusion of the War.

Soil Mechanics in Brazil

AMONG the papers contributed to the Third Reunion of the Brazilian National Laboratories for Testing Materials was one on soil stabilization, which has since been issued as a booklet by the National Institute of Technology, Rio de Janeiro. The author, Paulo Sá, outlines existing knowledge in this branch of the science of soil mechanics, in the hope of directing the attention of Brazilian engineers to this new and important science. This would be a commendable aspiration in any country. Too many engineers are unfamiliar with the extent to which the study of foundation and earthwork problems has been developed during the last ten or twenty years, for it is now legitimate to speak of the emergence of a rational science of soil mechanics, based on sound scientific principles and making full use of theory, experiment and practice. Here again, as in most cases of fresh scientific approach to an old problem, research has established a considerable lead on practical application. The Brazilian writer complains that, in his country, soil mechanics specialists are *muito poucos*: in Great Britain also they are all too few. But the subject is not only a matter for the specialist. It should become part of the training of all civil engineers. Emphasis has been laid on the need for greater attention to it in Great Britain in annual reports of the Building Research Board which, in its report for 1938, noted with satisfaction steps taken at several university institutions, following a conference at the Building Research Station, to bring the subject into greater prominence in the curriculum for engineering students.

Electric Heating in the Pottery Industry

THE new pottery factory of Messrs. Josiah Wedgwood and Sons, Ltd., at Barlaston, has been described in articles in the *Electric Review* of April 18 and May 2. For the first time in Great Britain, electrical biscuit and glost firing have been combined in one kiln. In biscuit firing the pottery is subjected to direct radiation from the source of heat instead of being stacked in the kiln in special containers (saggars). Both the biscuit and glost firing are effected in a double tunnel kiln of the conveyor type. The two tunnels—one biscuit and one glost—are side by side, so as to reduce construction costs and effect a measure of heat recuperation. In each tunnel there are a heating-up and a cooling-down section at opposite ends of the firing zone, and the sequence in the case of biscuit firing is opposite to that of glost firing. The overall length of the kiln is 272 ft. and the firing zone is about 100 ft. long. Each tunnel measures about 6 ft. by 4 ft. inside, just a little larger than the trucks which convey the wares through the kiln. The firing zone of each tunnel has a number of sections, the temperatures of which, as recorded by pyrometers on the outside walls and at the centres of the sections, follow a desired curve in each case, with a maximum in the case of biscuit firing of about 1,150° C. 'Kanthal' type or aluminium-iron elements consisting of strip about ½ in. wide wound spirally on a refractory former about 3 ft. long are used. Trucks carrying the pottery run on rails continuously through the kiln end to end as a train, the whole being propelled by a pusher unit, which operates with the end truck at the tunnel entrance. Enamelling firing for colour work demands a temperature of about 850° C., which

is low in comparison with biscuit and glost firing. The enamel firing is also done electrically, but this is not a new development although the kiln used for the purpose is new.

Jean Nicolas Corvisart (1755-1821)

IN a recent paper (*Proc. Roy. Soc. Med.*, 34, 239; 1941) on the life and times of Jean Nicolas Corvisart, after emphasizing the resemblance between the stirring events at the beginning of the nineteenth century and those at the present time, Dr. Halls Dally said that the genius of Laennec had almost eclipsed the glory of his teacher Corvisart, whom several biographers merely regarded as "First Physician to the Emperor Napoleon I". Corvisart, however, had greater claims to medical fame. He rescued the art of percussion invented by Auenbrugger from oblivion, perfected it, and was the father of cardiology. His great work on diseases of the heart and great vessels, which was published in 1806, marks the beginning of the clinical study of cardiology. His numerous distinguished pupils and successors included Bichat, the founder of biology, Bretonneau who discovered diphtheria, Bouillaud who first described the cardiac manifestations of rheumatic fever, Dupuytren who created the school of clinical surgery and Cruveilhier, the celebrated anatomist and pathologist.

Recent Earthquakes

A SEVERE earthquake just before noon G.M.T. on June 26 had its epicentre near the Nicobar Islands in the Bay of Bengal, north-west of Sumatra. It is not yet known how many casualties or how much damage was caused, but only twelve of these British governed islands are inhabited. The amplitudes caused by the earthquake on the seismographs throughout the world were comparable to those caused by the Quetta and Turkish earthquakes.

Earthquakes on the same day were experienced in eastern Morocco causing considerable damage but few casualties.

The U.S. Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association has calculated the provisional epicentres of the earthquakes of April 1, 3 and 7. The first was south of the Alaskan Peninsula near 56·0° N., 153·0° W., at 10h. 41·1m. G.M.T. The second was in Chile near 25° S., 69° W. at 15h. 21m. G.M.T. with a depth of focus near 200 km. The third was in the Caribbean Sea south of Jamaica near 17·6° N., 78·3° W. at 23h. 29·3m. G.M.T. All are in well-known seismic regions.

Institute of Fuel: Students' Medal

To encourage the preparation of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual award of a medal, together with a prize consisting of books and/or instruments to the value of £5, for a paper submitted by a student member of the Institute or by a student less than twenty-five years of age of any university or technical college in the United Kingdom. The paper must deal with some subject relating to the preparation or utilization of fuel, or allied subjects. Papers must be submitted to the Secretary of the Institute under a *nom de plume*, the name and address of the author being enclosed in a sealed envelope and sent with the paper, and must be received by the Secretary on or before September 1 in any year. Further particulars can be obtained from the Secretary, Institute of Fuel, 30 Bramham Gardens, London, S.W.5.

Announcements

THE Academy of Sciences of the U.S.S.R. has awarded the Pavlov Prize for 1940 to Prof. Maria K. Petrowa, professor at the Pavlov Institute of Physiology.

THE Royal Swedish Academy of Science has elected Sir Thomas Lewis, physician-in-charge of the Department of Clinical Research at University College Hospital, London, a foreign member of the Faculty of Medical Research.

MISS JULIA BELL, honorary Galton research fellow of University College, London, and member of the scientific staff of the Medical Research Council, has been awarded the Weldon Memorial Prize for 1941 of the University of Oxford.

MR. GRIFFITH BREWER has been elected president of the Royal Aeronautical Society for the year October 1941–September 1942; Prof. L. Bairstow, Mr. W. C. Devereux and the Right Hon. J. T. C. Moore-Brabazon have been elected vice-presidents for the same period.

PROF. CARL NEUBERG, formerly professor in biochemistry in Berlin, Amsterdam and Jerusalem, has been appointed professor of biochemistry at the New York University College of Arts and Science.

THE title of honorary reader in organic chemistry in the University of Leeds has been conferred upon Dr. J. W. Baker, lecturer in the Department of Organic Chemistry. Mr. T. G. Bridgwood has been appointed lecturer in electrical engineering.

The Council has agreed, on the recommendation of the Senate, that in general all men students of the University of seventeen and above should be required to become (if not already) members of the Senior Training Corps or the Air Training Squadron, or alternatively to undertake some other form of national service approved for the purpose.

A RESEARCH scholarship of the value of £250 per annum and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects and it is hoped to make the award in September 1941. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

A New Method for the Estimation of Trigonelline in Urine and Foodstuffs

THE recognition of trigonelline as a product of the metabolism of nicotinic acid is due to Ackermann[1], who in 1912 dosed dogs with nicotinic acid and found it to be partly excreted as trigonelline. Linneweh and Reinwein[2,3] isolated the latter substance from normal human urine, and found that the amount excreted was increased after the consumption of coffee. More recently Sarett, Perlzweig and Levy[4] reported that when human subjects were dosed with nicotinic acid, a portion of it, ranging from 10 to 15 per cent, was excreted as trigonelline. Melnick, Robinson and Field[5] have made similar observations. However, the exact relation between the excretion of trigonelline and intake of nicotinic acid remains to be investigated, and can only be settled after a satisfactory quantitative procedure for the estimation of trigonelline has been devised. The methods used by Sarett and his co-workers and by Melnick *et al.*, involve the conversion of trigonelline to nicotinic acid in the presence of strong alkali and ammonia. The conversion according to the former group of workers is 65–75 per cent, and according to the latter group 28–38 per cent. The amount converted seems to depend on the concentration of ammonium salts, the strength of alkali used, the length of hydrolysis, and possibly other factors, and the method at best is only semi-quantitative.

We have devised a new quantitative method for estimating trigonelline in urine and foodstuffs, based on the observation that when trigonelline is hydrolysed with alkali in alcoholic solutions, methylamine is split off, leaving the ring open. The resulting product can be combined with aromatic amines to give coloured compounds which can be measured quantitatively. Of a number of amines examined, we found benzidine to be the most satisfactory. It gives an orange-red derivative with the hydrolysed product, which seems to be specific for trigonelline. Pyridoxine (vitamin B_6), nicotinic acid, nipecotic acid and nicotine show no such reaction. The only other compound, so far as we are aware, which reacts similarly is *N*-methyl pyridinium hydroxide. By this method, 1·0 μ gm. of trigonelline per ml. of urine can be quantitatively estimated. The average recovery of added trigonelline to urine from eighteen trials was 95 per cent ($\pm$ 8 standard deviation). The procedure is as follows :

For urine : To 10 ml. of urine add ½ ml. of 40 per cent sodium hydroxide and heat on a boiling water-bath for twenty minutes. Cool, add 1 ml. of concentrated hydrochloric acid and 0·4 ml. of 10 per cent barium chloride solution, and then 40 ml. of 96 per cent ethanol. Add 0·5 gm. of Norite charcoal and shake for one minute. Filter and measure two 20 ml. portions of the filtrate into two 50 ml. conical flasks. To one of the flasks add 0·5 ml. of a standard trigonelline solution containing 50 mgm. per ml. Add 4·2 ml. of 40 per cent sodium hydroxide to each flask and heat on the water-bath for ½ hour. Cool, neutralize cautiously, and make up to 30 ml. Centrifuge, and measure two 10 ml. portions of the centrifugate into two test tubes, one for the blank and the other for the unknown. The blank should contain 1 ml. of 5 per cent hydrochloric acid, and the unknown 1 ml. of 1 per cent benzidine in 5 per cent hydrochloric acid. Allow one hour for the colour to develop, and then measure the colour in a Pulfrich photometer using filter number *S* 50.

For foodstuffs : With foodstuffs the preliminary digestion for twenty minutes is omitted. Measure 10 ml. of an extract of the material into a conical flask and treat with hydrochloric acid and barium chloride, and proceed as described above. In coffee and tea, 7·5 mgm./gm. and 0·13 mgm./gm. of trigonelline respectively were found.

The accompanying table shows some of the typical results obtained with urine.

EXCRETION OF TRIGONELLINE AND NICOTINIC ACID* BY A NORMAL INDIVIDUAL ON A COFFEE-FREE DIET AND AFTER DOSING WITH 50 mgm. AND 100 mgm. OF NICOTINIC ACID.

Description	Trigonelline excreted		Nicotinic acid excreted		Nicotinic acid + trigonelline total
	In mgm. per day	Increased excertion as % of nic. acid dosed	In mgm. per day	Increased excretion as % of nic. acid dosed	Increased excretion as % of nic. acid dosed
1st day—normal coffee-free diet	14·1	—	1·3	—	—
2nd ,, ,, ,, ,, ,,	11·0	—	1·1	—	—
1st day + 50 mgm. nicotinic acid	20·6	16·0	2·7	3·0	19·0
2nd ,, ,, ,, ,, ,,	21·5	18·0	2·2	2·0	20·0
1st day + 100 mgm. nicotinic acid	21·0	8·4	10·9	9·7	18·1
2nd ,, ,, ,, ,, ,,	34·3	31·7	11·3	10·1	41·8
3rd ,, ,, ,, ,, ,,	35·0	22·4	7·9	6·7	29·1
4th ,, ,, ,, ,, ,,	47·9	35·3	9·6	8·4	43·7
5th ,, ,, ,, ,, ,,	46·3	33·7	—	—	—
6th ,, ,, ,, ,, ,,	41·7	29·1	—	—	—

* By the modified method of Harris, Kodicek and Wang[6].

The excretion of trigonelline by normal individuals on a coffee-free diet ranged from 10 to 16 mgm. per day. After dosing with nicotinic acid the increased output of trigonelline varied from 10 to 28 per cent of the ingested dose, depending upon the size of the dose and the body weights of the subjects.

The metabolic connexion between trigonelline and nicotinic acid is of interest in relation to the test proposed for assessing the nutritional status of human subjects in the anti-pellagra vitamin (Harris and Raymond, 1939[7]). This depends on the measurement under controlled conditions of the urinary excretion of nicotinic acid or related substances. We have confirmed the conclusion of Harris and Raymond[7] that their method does measure essentially the nicotinic acid (which is biologically active), and that trigonelline (which is inactive), does not interfere. With the low concentration of alkali and the short period of hydrolysis used, no detectable amount of trigonelline is converted to nicotinic acid. The disadvantage of a prolonged digestion with stronger alkali, as used by Swaminathan[10], is that a considerable conversion of trigonelline into nicotinic acid occurs. The method of alkaline hydrolysis used by Harris and Raymond seems preferable to that of acid hydrolysis used by Melnick and Field[8], since the latter may involve an incomplete conversion of nicotinuric acid, and a darker digestion mixture. Also Melnick and Field[9], in criticizing the blank correction, seem to have overlooked the fact that the Cambridge workers employed an acid reaction medium, in which the urine reacts less with interfering substances than in the neutral medium used by Melnick and Field, and in which the bleaching effect of CNBr is entirely suppressed.

We have introduced certain modifications in the method of analysis which increase its sensitiveness and accuracy; these include the removal of interfering substances by preliminary adsorption on charcoal, control of period of hydrolysis and adjustments in the blank correction.

In conjunction with Dr. Harris we have confirmed again that the estimation of nicotinic acid, as such, in urine, in the absence of test-dosing (that is, measurement of 'resting level' of excretion) does give an indication of the past intake of nicotinic acid and hence of the anti-pellagra status of the subject: thus in deficiency in humans, in dogs and in guinea pigs the excretion of nicotinic acid falls either to zero or to a very low level[6]. Indeed, in ordinary circumstances it seems preferable to estimate the nicotinic acid rather than the trigonelline in a specimen of urine, because, unless special precautions have been taken to make the diet free of trigonelline, it may be excreted in large amounts as such in the urine, even when there has been no nicotinic acid in the diet and the subject is actually deficient. For test-dosing on the other hand ('saturation tests') the most satisfactory procedure would appear to be to administer nicotinamide and estimate both the trigonelline and the nicotinic acid excreted while the subject is kept on a controlled diet low in trigonelline. Our reason for this recommendation is the finding that when doses of nicotinic amide are given the product excreted in the urine is almost entirely trigonelline, while with a nicotinic acid dose both trigonelline and nicotinic acid (or nicotinic acid-like substances) are found. The possible explanation may be that nicotinic acid given by mouth has first to be converted by the organism into nicotinamide before being excreted as trigonelline, and any excess which escapes this conversion will be excreted as nicotinic acid-like substances. On the other hand, nicotinamide is utilized as such and there is no overflow of nicotinic acid-like substances, but only an increased excretion of trigonelline.

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Medical Research Council,
Dunn Nutritional Laboratory,
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May 28.

[1] Ackermann, *Z. Biol.*, **59**, 17 (1912).
[2] Linneweh and Reinwein, *Z. physiol. Chem.*, **207**, 48 (1932).
[3] Linneweh and Reinwein, *ibid.*, **209**, 110 (1938).
[4] Sarett, Perlzweig and Levy, *J. Biol. Chem.*, **135**, 483 (1940).
[5] Melnick, Robinson and Field, *ibid.*, **136**, 131, 145 (1940).
[6] Harris, Kodicek and Wang, in the Press.
[7] Harris and Raymond, *Biochem. J.*, **33**, 2037 (1939).
[8] Melnick and Field, *J. Biol. Chem.*, **134**, 1 (1940).
[9] Melnick and Field, *ibid.*, **135**, 53 (1940).
[10] Swaminathan, *Ind. J. Med. Res.*, **27**, 417 (1939).

Sulphanilylguanidine

IN view of the present interest in the trial of sulphanilylguanidine for the treatment of bacillary dysenteries[1] it may be useful to direct attention to a convenient method for the preparation of this substance by the fusion of sulphanilamide with dicyandiamide which we described some years ago. In our original description of this reaction[2] it was assumed that the substance isolated was formed by the addition of the cyanamide group at the N4 position to give 4-sulphonamidophenylguanidine; NH : (NH_2) $CNHC_6H_4.SO_2NH_2$; actually addition takes place at the N1 position to give sulphanilylguanidine, $NH_2C_6H_4.SO_2NH.C(NH_2)$: NH completely identical with the product recently obtained by Marshall *et al.*[3] by the interaction of *p*-acetylaminobenzesulphonyl chloride and guanidine. Marshall's synthesis leaves no doubt about the correct constitution of the substance, which is confirmed also by the insolubility of the substance in alkali and the development of colour on diazotizing and coupling.

We are much indebted to Prof. E. K. Marshall, jun., who has kindly directed our attention to the identity of the substance produced by these two reactions.

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SYDNEY SMITH.

Wellcome Chemical Research Laboratories,
Beckenham.

[1] Marshall, E. K., Bratton, A. C., Edwards, L. B., and Walker, E., *Bull. Johns Hopkins Hosp.*, **94** (January, 1941).
[2] Buttle, Dewing, Foster, Gray, Smith and Stephenson, *Biochem. J.*, **32**, 1101 (1938).
[3] Marshall, Bratton, White and Litchfield, *Bull. Johns Hopkins Hosp.*, **67**, 183 (1940).

Vitamin A in Canned Salmon

IN a communication in NATURE[1], Pyke and Wright have commented on the high values for the vitamin A contents of salmon-body and salmon-flesh oils given in the tables of Fixsen and Roscoe[2]. In their own experiments they have failed to detect any vitamin A by the antimony trichloride method

in twelve specimens of canned and two of chilled salmon flesh.

While the upper values quoted by Fixsen and Roscoe certainly seem beyond the range reported by most investigators, my own experience does not support the view of Pyke and Wright that canned salmon is quite devoid of vitamin A. In four specimens purchased locally, I have found 5, 120, 120 and 150 I.U. of vitamin A per 100 gm. of flesh by the antimony trichloride method, applied to the unsaponifiable fraction. These results agree with the findings of most previous workers that canned salmon contains small but appreciable amounts of vitamin A.

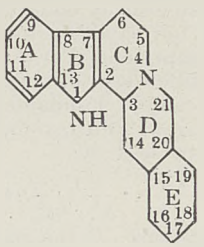
T. MOORE.

Nutritional Laboratory,
Cambridge.
May 16.

[1] Pyke, M., and Wright, M. D., NATURE, 147, 267 (1941).
[2] Fixsen, M. A. B., and Roscoe, M. H., *Nutrit. Abstr. Rev.*, 7, 823 (1937-38): 9. 795 (1939-40).

Constitution of Yohimbine

IT has been suggested by D. G. Harvey, E. J. Miller and W. Robson in a recent publication[1] on the colour reactions of tryptophan and allied compounds—among them the alkaloid yohimbine—that the formation of a *blue* colour in sulphuric acid containing a trace of oxidizing agent is characteristic of the 4-carboxytetrahydro-β-carbolines. The presence in yohimbine of both tetrahydro-β-carboline and carboxylic acid (actually carbomethoxyl) residues has been recognized for some time, and it is clear from the formation in good yields of 2 : 3-dimethylbenzoic acid from ketodihydroyobyrine[2], and of harman and *m*-toluic acid from tetradehydroyohimbic acid[3], that the carbomethoxyl must be attached to the yohimbine skeleton, which is as depicted, in ring *E* at position 16.



Harvey, Miller and Robson do not, however, refer to this evidence, but conclude that the carbomethoxy-group is located at C_5 because the alkaloid displays a 'carboline-blue' colour reaction.

We have been engaged on experiments on the constitution of yohimbine, and by distilling yohimbic acid with copper and cupric oxide instead of alkali have improved Hahn's preparation of yohimbol[4]. The complete identity which we have observed between the sulphuric acid colour transformations of this *carboxyl-free* secondary alcohol and of yohimbine entirely invalidates the evidence on which the suggested alternative formula rests. With regard to the position of the alcoholic hydroxyl, which Hahn[5] disposes at C_{17}, it appears to us that the available evidence strongly favours its existence at C_{19}, and we propose for the alkaloid a structure having the groups $--CO_2Me$ and $—OH$ at positions 16 and 19 respectively.

M. J. S. DEWAR
F. E. KING.

Dyson Perrins Laboratory,
Oxford.
June 4.

[1] *J. Chem. Soc.*, 153 (1941).
[2] Barger and Scholz, *Helv. chem. Acta*, **16**, 1343 (1933).
[3] Hahn, Kappes and Ludewig, *Ber.*, **67**, 686 (1934).
[4] Hahn and Stenner, *Ber.*, **61**, 278 (1928).
[5] Hahn and Hansel, *Ber.*, **71**, 2192 (1938).

Salaman's Culture of Blight Resistant 'Aya papa'

A FURTHER note may be of interest in connexion with Reddick's paper, "Whence came *Phytophthora infestans*?"[1], on the question of the distribution of blight resistant potatoes in the American continent.

Blight resistance has so far been found only in Mexico with the exception of a plant known as 'Aya papa' from Ecuador. Salaman's culture of this plant is immune, but Reddick considers that this is not the original Aya papa collected by P. T. Knappe but a *Solanum demissum* hybrid in about the first back-cross stage.

Cytological examinations of root tip preparations made by us from Salaman's Aya papa show that the specimen is a pentaploid with 60–62 somatic chromosomes. The chromosome number thus confirms Reddick's suggestion that Salaman's culture of Aya papa is a hybrid between *S. demissum* ($2n = 72$) and *S. tuberosum* ($2n = 48$). The plant also shows many morphological similarities to *S. demissum*, especially in such floral details as the short corolla lobes and characteristic 'star'.

We were at first inclined to consider that Knappe's original plant was also a *S. demissum* hybrid, but both Bukasov (see Reddick[1]) and Black (in a private communication), who obtained their cultures direct from Knappe, found it to be susceptible. Furthermore, their descriptions (Bukasov[2], Black, in a private communication) do not agree with Salaman's culture. A further piece of evidence comes from Ecuador itself. One of us (J. G. H.) when in Riobamba (whence Knappe was said to have obtained his tubers of Aya papa) was able to ascertain that potatoes known as Aya papa did actually occur in certain localities, growing apparently wild in the vicinity of native habitations and villages. They are regarded by the Indians as potatoes which were cultivated by their ancestors—hence the Quechua name 'Aya', which means 'dead person, ghost or ancestor' and 'papa', signifying 'potato'.

All evidence, therefore, points to the conclusion that Knappe's Ecuadorean potato was not blight resistant and that this quality has not yet been discovered outside Central Mexico.

J. G. HAWKES.
H. W. HOWARD.

School of Agriculture,
Cambridge.
June 14.

[1] Reddick, D., *Chronica Botanica*, 5, 410–12 (1939).
[2] Bukasov, S. M., Suppl. 58, *Bull. Appl. Bot. Leningrad*, 192 (1933).

The Recombination Law for Weak Ionization

IN order to explain the observed relation between the number of condensation nuclei in atmospheric air and the ionization, an equilibrium equation was proposed[1] of the type $q = an + bnZ$, where q is the rate of production of ion-pairs per cm., n and Z the concentrations of small ions (of one sign) and nuclei, and a and b are constants for any given conditions. This implies that, in atmospheric air, the rate of loss of ions by recombination among themselves is proportional to n and not to n^2. It was suggested that, where a volume of air is traversed at any time by only a few ionizing particles, the rate of loss of ions from the space by recombination is proportional to the number of ion tracks and hence approximately to n.

To test this view, experiments have been carried out on air free from nuclei contained in a vessel of volume 730 litres. The intensity of the ionization inside the vessel was varied by placing a small quantity of radium at different distances from it. Observations were made of n for different values of q. In experiments of this kind, ions are lost by diffusion as well as by recombination, and the chief difficulty is to make a proper allowance for this loss. In this work, correction for diffusion has been made on the lines developed by Power[2], and it is believed that the corrected values of n are fairly accurate.

Using corrected values of n, and plotting log n against log q, we obtain a graph the slope of which varies. For values of q between 360 and 120, the slope is 2·0, in agreement with the ordinary law $q = \alpha n^2$. For lower values of q the slope becomes less. For values of q between 30 and 12, it is approximately 1·45. Experiments in the range $q < 12$ have not as yet been possible. Putting the law in the form $q = kn^p$, the experiments indicate a considerable diminution in the value of p over the range of observation. It is possible that with lower values of q, p may approach to unity, giving the linear recombination law proposed to explain the equilibrium of ionization in the atmosphere.

It is perhaps worthy of note that in the region where the law $q = \alpha n^2$ appears to hold, the calculated value of α is $1{\cdot}56 \times 10^{-6}$, which is closer to the values obtained by the earlier workers than to the more recent values such as that of Sayers[3].

P. J. NOLAN.

University College,
Dublin. June 3.

[1] Nolan, J. J., *Proc. Royal Irish Acad.*, **46**, 77 (1940).
[2] Power, A. D., *J. Frank. Inst.*, **96**, 327 (1923).
[3] Sayers, J., *Proc. Roy. Soc.*, A, **169**, 83 (1938).

Surface Films of Polar Crystals

THE study of atomic monolayers was initiated by Miss Pockels and the late Lord Rayleigh long ago, for capillary surfaces. It was capable of extension to electric crystalline structure, on the basis of the analysis of local polarization which is to be found in Maxwell's "Treatise" but is usually quoted under the names of Clausius and Lorentz. It compels the result that for a crystal polarized transverse to its surface a monolayer of compensating ions is required on its face, but in number *half* that in each ionic sheet of the crystal[1].

I have looked for a long time for some confirmation of so remarkable a result. The fundamental discovery of the diffraction of uniform pencils of electrons at the surface of a crystal, independently by Davisson and Germer in New York and by G. P. Thomson and A. Reid in Aberdeen, gave promise in this direction. This subject has now grown into an immense technical science with which only experts can be familiar, as is illustrated in the recent treatise by G. P. Thomson and W. Cochrane[2]. In turning over its pages I have hit upon the confirmation which I wanted, relating to the surface film, in a passage (p. 270) here reproduced, on the diffraction of pencils of slow electrons. It describes results reported in Davisson and Germer's early memoir.

"The new beams . . . thus possess the character of plane- rather than space-grating beams. Measurement shows, however, that the plane-grating spacing to which they correspond is in each case exactly twice that of the nickel atoms in the azimuth in question."

I have, however, not succeeded in explaining the concept of an index of refraction of the electrons along such lines.

JOSEPH LARMOR.

Holywood,
Northern Ireland. May 12.

[1] Cf. Larmor, "Mathematical and Physical Papers", 2, 620–29 (1928), "On Electro-crystalline Properties as conditioned by Atomic Lattices" reprinted from *Proc. Roy. Soc.*, A, **99** (1921), following on earlier discussions in *Phil. Trans.*, **2**, 44–50 (1897).
[2] "Theory and Practice of Electron Diffraction" (Macmillan, 1939).

Flow Properties of Some Thermoplastics

Scott Blair and Coppen[1], dealing with the compression of cylinders under constant stress, have given a general method of specifying the rheological properties of plastic materials by making use of two characteristics ψ, k given by

$$\psi = s\sigma^{-1}\, t^k, \qquad . \quad . \quad . \quad (1)$$

where s, σ, t have their usual meaning. Broome and Bilmes[2] have confirmed the validity of the treatment by their work on the stretching of asphalt strips.

Scott Blair[3] had previously suggested a modification of the Bingham-Murray equation for the emptying of an initially full capillary tube, instead of the usual filling of an empty one. For the case of materials not obeying Poiseuille's law, he suggested a parabolic plot of the data obtained. Fundamentally, as applied to the original Bingham-Murray method, this modification can be expressed by

$$\Psi = \frac{PR^2}{4} \cdot \frac{1}{h^2 - h_0^2}\, t^K, \qquad . \quad . \quad (2)$$

where P is the pressure, R the radius of capillary, h the length of extrusion, t the time, and h_0 is the extrusion at time $t = 0$, and the exponent K "differs from unity to an extent which is the measure of the discrepancy from truly fluid behaviour". When $K = 1$, Ψ corresponds to a true viscosity. There is a formal similarity between equations (1) and (2).

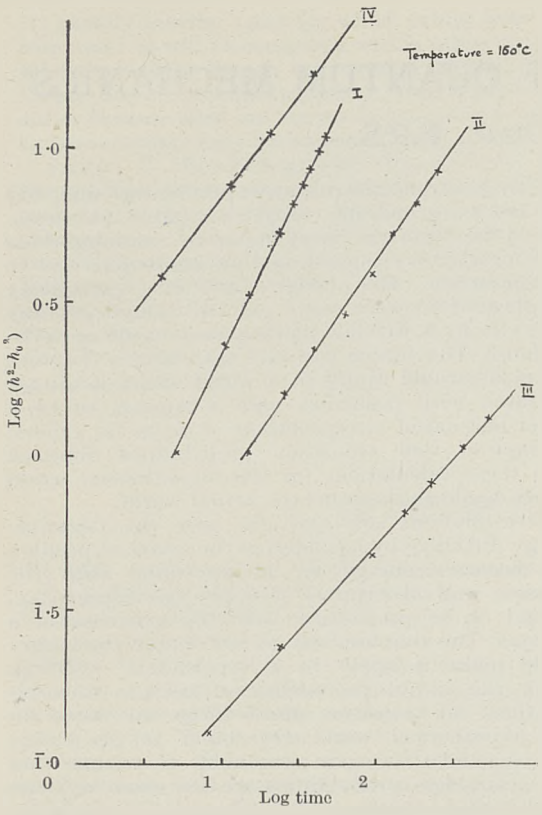
The value of the stress averaged across a diameter of the tube is $PR/4h$. From a comparison of the differential form of the Bingham-Murray equation

$$\frac{d}{dt}\left[\frac{2h}{R}\right] = \frac{1}{\eta}\,\frac{PR}{4h} \qquad . \quad . \quad . \quad (3)$$

with the equation defining the viscosity, η,

$$\frac{d\sigma}{dt} = \frac{1}{\eta}\, s, \qquad . \quad . \quad . \quad . \quad . \quad (4)$$

we see that $2h/R$ can be regarded as the value of the strain averaged across a diameter. Using this ex-



	Thermoplastic	K	Ψ
I	Tenite I (M.S.)	1·0	1·17 × 10³
II	Tenite II (M.)	0·74	1·35 × 10³
III	Cellulose Acetate, low plasticizer content	0·57	9·55 × 10³
IV	Polystyrene	0·54	1·60 × 10²

pression for the strain, and defining Ψ by the equation

$$\Psi = s\left[\frac{d\sigma}{dt\dot{K}}\right]^{-1}, \quad . \quad . \quad . \quad . \quad (5)$$

we obtain (2) by direct integration. Equation (5) is, in effect, the Scott Blair and Coppen equation (1) adapted to differential analysis.

For constant pressures we have found that plots of $\{\log(h^2-h_0^2), \log t\}$ give straight lines in the case of many thermoplastics, and thus reveal K.

Then

$$\log\Psi = \log\frac{PR^2}{4} + K - \log(h_{10}^2-h_0^2)$$

where h_{10} is the extrusion after 10 seconds.

Since the average stress $PR/4h$ falls off as the flow proceeds, there is no suggestion that the conditions for a basic analysis of flow (that is, constant stress) are being satisfied. The above treatment, however, seems well suited to the specification of the flow properties of thermoplastics. Further investigation along these lines is in progress.

We have to thank the directors of the British Xylonite Co., Ltd., for permission to publish this note.

Physical Laboratory,
Halex, Ltd.,
Hale End, E.4.

W. G. WEARMOUTH.
I. I. BERENBLUT.

[1] Scott Blair, G. W., and Coppen, F. M., NATURE, 146, 840 (1940).
[2] Broome, D. C., and Bilmes, L., NATURE, 147, 176 (1941).
[3] "An Introduction to Industrial Rheology", p. 55.

'Shot Effect' in Temperature-Limited Diodes

THE 'shot effect' in temperature-limited (saturated) diodes has certain similarities with the 'Johnson effect' observed in electrical resistances. Though the classical formula of the shot effect may be derived in several different ways, to my knowledge it has not yet been done on the same lines as those used for obtaining a formula for the Johnson effect. J. Bernamont[1] has shown that the 'Johnson effect' formula—namely, $\overline{e^2}\nu = 4RkT$, may be obtained in the electronic theory of metals, using either the Lorentz or Sommerfeld theory of conductivity. The purpose of this note is to show that, following Bernamont's method for the Johnson effect, one may derive the classical formula of the shot effect.

Let $f(u)S.dx.du$ be the number of electrons in the volume element $S.dx$, dx being the length of the trajectory of an electron the velocity of which lies between u and $u+du$, and S the emitting area of the filament. Owing to the Maxwellian distribution of the electrons emitted by the filament, we have:

$$f(u)du = n2hme^{-hmu^2}du,$$

with $hmu_c^2 = 1$ and $1/2mu_c^2 = kT$, where T is the temperature of the filament. An electron of velocity u is equivalent to a current element the length of which is dx, and:

$$\delta j dx = u\varepsilon,$$

ε being the electron charge.

The mean square of the current is then:

$$\overline{j^2} = Sdx\int_0^\infty \frac{\varepsilon^2u^2}{dx^2}f(u)du.$$

M. Courtines[2] has shown that the 'correlation function' of the current in a saturated diode is, where θ is the time of correlation,

$$\begin{cases}\overline{ii_t} = \dfrac{\theta-|t|}{\theta}\overline{j^2}, & \text{for } |t|\leq\theta\\ \overline{ii_t} = 0 & \text{for other values of } t.\end{cases}$$

The 'spectral component of intensity' of a function y, for 'infinitely brief' correlation, that is, for frequencies ν satisfying the relation $\nu << 1/\theta$ is[1]:

$$\overline{y_\nu^2} = 4\int_0^\infty \overline{yy_t}dt,$$

whence:

$$\overline{i_\nu^2} = 4S\varepsilon^2\int_0^\infty \frac{1}{dx}\cdot f(u)u^2du\int_0^\infty \frac{\theta-|t|}{\theta}\,dt,$$

and

$$\overline{i_\nu^2} = 2S\varepsilon^2\int_0^\infty \frac{\theta}{dx}\cdot f(u)u^2du.$$

Now:

$$\theta/dx = 1/u, \text{ and } \overline{i_\nu^2} = 2S\varepsilon^2\int_0^\infty f(u)udu;$$

so that

$$\overline{i_\nu^2} = 2S\varepsilon^2 n.$$

But

$j = S\varepsilon n$ is the mean diode current; hence finally:

$$\overline{i_\nu^2} = 2\varepsilon j.$$

M. SURDIN.

Repatriation Office,
37 Rua da Emenda,
Lisbon.
May 24.

[1] Bernamont, J., *Ann. Phys.*, 7, 71 (1937).
[2] Courtines, M., Congrès International d'Électricité, Paris, 1932.

PHYSICAL INTERPRETATION OF QUANTUM MECHANICS*

By PROF. P. A. M. DIRAC, F.R.S.

MODERN developments of atomic theory have required alterations in some of the most fundamental physical ideas. This has resulted in its being usually easier to discover the equations that describe some particular phenomenon than just how the equations are to be interpreted. The quantum mechanics of Heisenberg and Schrödinger was first worked out for a number of simple examples, from which a general mathematical scheme was constructed and afterwards people were led to the general physical principles governing the interpretation, such as the superposition of states and the indeterminacy principle. In this way a satisfactory non-relativistic quantum mechanics was established.

In extending the theory to make it relativistic, the developments needed in the mathematical scheme are easily worked out, but difficulties arise in the interpretation. If one keeps to the same basis of interpretation as in the non-relativistic theory, one finds that particles have states of negative kinetic energy as well as their usual states of positive energy, and, further, for particles the spin of which is an integral number of quanta, there is the added difficulty that states of negative energy occur with a negative probability.

* Substance of the Bakerian Lecture of the Royal Society, delivered on June 19.

With electrons the negative-probability difficulty does not arise, and one can get a sensible interpretation of the negative-energy states by assuming them to be nearly all occupied, and an unoccupied one to be a positron. This model, however, is excessively complicated to work with and one cannot get any results from it without making very crude approximations. The simple accurate calculations that one *can* make would apply to a world which is almost saturated with positrons, and it appears to be a better method of interpretation to make the general assumption that transition probabilities obtained from these calculations for this hypothetical world are the same as those for the actual world.

With photons one can get over the negative-energy difficulty by considering the states of positive and negative energy to be associated with the emission and absorption of a photon respectively, instead of, as previously, with the existence of a photon. The simplest way of developing the theory would make it apply to a hypothetical world in which the initial probability of certain states is negative, but transition probabilities calculated for this hypothetical world are found to be always positive, and it is again reasonable to assume that these transition probabilities are the same as those for the actual world.

OBSERVATIONS MADE AT THE ROYAL OBSERVATORY, GREENWICH

THE observations made during 1936 at the Royal Observatory, Greenwich, have just recently been made available*.

The work is divided into five sections, the first of which, Section A, Meridian Astronomy, contains three subdivisions. Under (1), Transit Circle, 1936, the observed right ascensions, declinations and diameters of the sun, moon and planets are given and compared with the corresponding results as given in the "Nautical Almanac." These tabular places are derived from the well-known tables of Newcomb, Brown and Hill. The mean monthly corrections to Newcomb's place of the sun as given in the "Nautical Almanac" are shown, and also the corrections in longitude and latitude to Brown's "Tables of the Moon". These are deduced from the observed corrections to the right ascension and declination, the mean correction to the former being $0{\cdot}15^s$, corresponding to $2{\cdot}2''$ in mean longitude. Under (2), Time Service, is included a brief description of the reversible Transit "B" which was remounted on January 24, 1935, its place having previously been taken by Transit "D" on April 7, 1933. Collimation is eliminated by reversing the instrument on all stars, and observations are carried up to approximately 20^s of the meridian. Eighteen contacts are observed in each position of the instrument, when possible, and each signal is read to $0{\cdot}01^s$. Table II gives details of observation of clock corrections, and comparisons of Clocks Shortt Nos. 3 and 11 appear in Table V. The Greenwich time determinations are regularly compared with those of other observatories by the reception of wireless signals and the results are given in Table VIII. Under (3), Variation of Latitude, it is pointed out that as the Cookson floating zenith telescope was moved in 1936 to the Christie enclosure and remounted, a new observing programme being introduced at the same time, the results for the latitude variation given by the instrument will not be published for some time. The values of the latitude variation taken from the results of the International Latitude Service are given, and these have been used in the Transit Circle reductions.

Section B, Equatorial Observations, contains the results of the observations of double stars made with the 28-inch refractor. The list deals with the first observations carried out on the programme drawn up in 1936; the pairs were selected from Aitken's "New General Catalogue of Double Stars." These pairs were chosen on the following grounds:

* Observations made at the Royal Observatory, Greenwich, in the Year 1936, in Astronomy, Magnetism and Meteorology, under the direction of Dr. H. Spencer Jones. Pp. viii+A78+B16+Cix+161+D66+E46+38. (London: H.M. Stationery Office, 1939.) 35*s*. net.

(1) rapidly moving pairs for which orbits have been computed or will be computed within a few decades; (2) pairs which, though not moving rapidly, nevertheless deserve an observation in the present decade, either because they are known to have a slow motion or because they may be neglected pairs.

Section C, Photoheliographic Observations, gives the positions and areas of sunspots and faculæ for each day in the year 1936. Photographs from three observatories were used. Those obtained at the Royal Observatory, Greenwich, were taken with the Dallemeyer photoheliograph of 4 in. aperture, usually stopped down to 2·9 in., and, in a few cases, with the Thompson photoheliograph of 9 in. aperture. The diameter of the sun's image at the secondary focus in both instruments is 7½ in. at the earth's mean distance. The photographs from the Cape Observatory were taken with a Dallmeyer photoheliograph giving an image of the sun about 7½ in. in diameter. Those obtained at Kodaikánal were taken with a Cooke photovisual object-glass of 6 in. aperture, the image of the sun being on nearly the same scale. This section also gives a general catalogue of groups of sunspots for 1936 and 'ledgers' of the areas and heliographic positions of groups of sunspots for 1936.

Sections D and E, Magnetic and Meteorological Observations, give a full description of the buildings and equipment of the magnetic station at Abinger and also of the results of the magnetic observations, followed by a corresponding description of the meteorological apparatus and the results of the observations.

CONCRETE IN SEA WATER

THE current issue of the *Dock and Harbour Authority* contains the reproduction from the *Proceedings of the American Society of Civil Engineers* of a paper by Homer M. Radley in which the author gave a statement of the conclusions he has reached as a result of extended observation of concrete marine structures along the Pacific coast of the United States and Canada. Contrary to the widely held view that decomposition of concrete in sea water must necessarily occur as a result of the chemical action of sulphate of magnesium, he states that, over a long period no evidence of any attack of this nature was found, and he holds that such deterioration as occurs is due to other causes.

Arguing from the characteristic form and manifestation of attack by magnesium sulphate as advanced by Vicat, he concludes that, if this occurred in the manner described, exposure to full sea-water action for a period of twelve or fifteen years should produce distinct evidence of porosity or disintegration. His investigation showed, on the contrary, that concretes made with many brands of Portland cement continue after fifteen or more years of service to exhibit the original wood-grain and other marks of the shuttering used in construction. He points to several other causes of disintegration and disruption —the rise and fall of the tides and the alternate wetting and drying of the concrete surface, mechanical blows and abrasion from flotsam and drift, and the action of storm waves and the grinding of the boulders which they toss about. Deficiencies in the quality and structure of the concrete are responsible for the most characteristic forms of deterioration, weak concrete being readily abraded, honeycombed areas becoming cavitated, laitance seams giving rise to extended voids and so on. In these respects he finds little to choose between fresh water and salt water, and contends that the same qualities which give resistance in the one are good in the other. Associated with salt water there is, however, the scaling and disruption which arise from the crystallization of salt in the exposed upper parts. These several aspects of deterioration are discussed in considerable detail, and many photographs illustrate the different types noted.

THE IMPERIAL CANCER RESEARCH FUND

By Dr. E. Boyland

THE thirty-eighth annual report of the Imperial Cancer Research Fund was presented to the general meeting of governors in April. New work on the nature and cause of cancer has been carried out in the Fund's laboratories at Mill Hill. In addition to this normal work, Miss Ida Mann and Dr. B. D. Pullinger have carried out experiments on the effect of ascorbic acid in mustard gas burns of the eye, and on other problems for the Ministry of Supply. Several members of the staff have been absent on war service and, although the volume of research is perhaps not so large as in normal years, work of interest and real value has been accomplished.

Histology is still an important and essential branch of cancer research. Without the microscope it would often be difficult or impossible to determine whether tumours were malignant or not. Dr. L. Foulds has written a critical review on the histology of tumours[1], a field in which workers in the Imperial Cancer Research Fund laboratories have made important contributions in the past.

Dr. B. D. Pullinger has extended her investigation on the specific response which is given by mouse skin to carcinogenic substances. With the carcinogenic 5:9:10-trimethyl-1:2-benzanthracene small amounts produce the response while larger amounts destroy the epithelium without producing the characteristic reactions. This result fits in with the finding of Prof. E. L. Kennaway and Prof. J. W. Cook that this substance is a more effective carcinogenic agent in dilute than in strong solutions.

Mr. H. G. Crabtree has continued his investigations

on biological effects of organic chlorine compounds. The effect of chlor compounds on the carcinogenic action of benzpyrene is rather complicated and varies with their concentration, type and time of application. Application of low concentrations of chloracetone alternately with benzpyrene to the skin of mice reduces the carcinogenic action, but if a higher concentration of chloracetone is applied after discontinuing the applications of benzpyrene, the carcinogenic action is enhanced. The effect of a series of chlor compounds can be correlated to some extent with their chemical and physical properties.

Tumours can be induced in animals either with biologically produced agents or with synthetic carcinogenic compounds. Some time ago Dr. R. J. Ludford described the transformation of normal chick fibroblasts into malignant cells induced by treating tissue cultures of fibroblasts with filtrates of fowl sarcomas. It has so far not been possible to produce an analogous change with carcinogenic compounds. Cultures of cells from pure-line mice were grown in the presence of methyl cholanthrene or 3 : 4-benzpyrene for times varying up to six months without producing malignant cells.

Dr. W. J. Purdy and Dr. R. J. Ludford have continued to investigate the factors present in birds with retrogressing filterable tumours. The blood of ducks in which the Fujinami tumour was retrogressing did not neutralize the corresponding virus, nor did it inhibit the growth of the tumour cells in tissue culture. Thus it has not been possible to determine the nature of circulating antitumour factors, if indeed such occur, when multiple tumours retrogress. It is probable that the action of the effect on tumours is indirect. Dr. R. J. Ludford has grown fragments of rat uterus and vagina in culture and treated the isolated tissues with œstradiol. Neither in these experiments nor in others, in which cultures of combs from chick embryos were grown in the presence of testosterone, did the hormones have any effect on growth. The hormones must therefore act indirectly.

The Fund has continued to co-operate with other laboratories and is still particularly helpful in maintaining and supplying many strains of transplantable animal tumours. During the past year the Fund has been fortunate in having received more than £17,000 in legacies; the whole of which has been added to the endowment fund.

[1] *Amer. J. Cancer*, **39**, 1 (1940).

APPOINTMENTS VACANT

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

LECTURER IN GEOGRAPHY at the Brighton Municipal Training College for Women—The Education Officer, 54 Old Steine, Brighton (July 12).

LECTURER IN MATHEMATICS and A WOMAN LECTURER IN GEOGRAPHY—The Principal, Derby Technical College, Normanton Road, Derby (July 12).

INSTRUCTOR IN WORKSHOP PRACTICE AND PROCESSES in the Schools of Technology, Art and Commerce (Engineering Department)—The Chief Education Officer, City Education Office, 77 George Street, Oxford (July 15).

PRINCIPAL of the Lancaster Storey Institute Technical College and Junior Technical School—The Director of Education, Education Offices, High Street House, Lancaster (July 19).

TEACHER OF ENGINEERING SUBJECTS—The Acting Principal, Technical Institute, Ashford, Kent.

LECTURER IN ENGINEERING for the Achimota College, Gold Coast—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9687).

ASSISTANT ENGINEER for the Malayan Government Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9306).

HEAD OF THE CHEMISTRY AND APPLIED CHEMISTRY DEPARTMENT of the Royal Technical College, Salford—The Director of Education, Education Office, Chapel Street, Salford, 3.

ASSISTANT ENGINEER in the Government of Zanzibar Public Works and Electricity Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9634).

MAINTENANCE ENGINEER in the Government of British Guiana Transport and Harbours Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9393).

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Friday, July 18

INSTITUTE OF PHYSICS (MANCHESTER BRANCH) (in the Physics Department, University, Manchester), at 7 p.m.—Dr. H. Spencer Jones, F.R.S.: "Problems connected with the Construction of Large Telescopes, with special reference to the 200-inch Instrument".*

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1941, June 7. Pp. 16. (London: Royal Observatory, Greenwich.) [106

London Bird Report for 1940 : Being an Annual Report on Bird-Life within Twenty Miles of St. Paul's Cathedral. Compiled by R. S. R. Fitter. Pp. 20. (London: London Natural History Society.) 1*s.* 6*d.* [126

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1940. Pp. 150. (Bristol: The University.) [126

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 12: On *Salpingostoma dasu*, a New Carboniferous Seed from East Lothian. By Prof. W. T. Gordon. Pp. 427–464+6 plates. (Edinburgh and London: Oliver and Boyd.) 7*s.* [136

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1940, presented to the Annual Meeting, 10th March, 1941. Pp. 12. (York: Yorkshire Museum.) [136

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 25, 1940. Pp. 609. (London: Society of Chemical Industry.) 16*s.*; to Members, 7*s.* 6*d.* [166

Other Countries

India Meteorological Department. Scientific Notes, Vol. 8, No. 89 : Synoptic and Aerological Study of a Thunderstorm-day at Agra, December 3rd, 1936. By S. Basu and Ram Sahay. Pp. 67–76+6 plates. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 6*d.* [106

Annual Report of the United States Commissioner of Education for the Fiscal Year ended June 30, 1940. Pp. v+105. (Washington, D.C.: Government Printing Office.) 20 cents. [126

U.S. Treasury Department: Coast Guard. Bulletin No. 29 : International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1939. Pp. v+133. (Washington, D.C.: Government Printing Office.) [126

U.S. Office of Education: Federal Security Agency. Bulletin, 1940, No. 7: Laws Affecting School Libraries. By Edith A. Lathrop and Ward W. Keesecker. Pp. viii+136. (Washington, D.C.: Government Printing Office.) 20 cents. [126

The Meteorology of Great Floods in the Eastern United States. By Charles F. Brooks and Alfred H. Thiessen. (From the Smithsonian Report for 1938.) (Publication 3506.) Pp. 325–348. (Washington, D.C.: Government Printing Office.) [126

Hurricanes into New England—Meteorology of the Storm of September 21, 1938. By Charles F. Brooks. (From the Smithsonian Report for 1939.) (Publication 3563.) Pp. 241–251. (Washington, D.C.: Government Printing Office.) [126

Records of the Geological Survey of India. Vol. 75, 1940, Professional Paper No. 8 : Manganese-Ore in Bamra State. By Dr. M. S. Krishnan and Dr. P. K. Ghosh. Pp. 22+iv+3 plates. 14 annas; 1*s.* 3*d.* Vol. 75, 1940, Professional Paper No. 12 : An Earthquake in the Great Pamir. By Dr. A. L. Coulson. Pp. 11+2 plates. 7 annas; 8*d.* (Calcutta: Geological Survey of India.) [166

U.S. Office of Education: Federal Security Agency. Bulletin, 1940, No. 5: Bibliography of Research Studies in Education, 1938–1939. By Ruth A. Gray. Pp. xiv+411. (Washington, D.C.: Government Printing Office.) 35 cents. [166

Bulletin of the American Museum of Natural History. Vol. 77, Art. 9: The Birds of Mt. Auyantepui, Venezuela. By E. Thomas Gilliard. Pp. 439–508. (New York: American Museum of Natural History.) [166