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Reform of the British Patent System.*

THE need for various improvements in the British patent system has been constantly before the public in recent years, and it is generally agreed that the time is ripe for a general overhauling and lubrication of the machinery. The matter is important, for invention is closely, if subtly, connected with unemployment, and, moreover, it is chiefly through patent protection that workers in applied science can hope to win a share of the economic benefits which they confer on the community.

It is therefore satisfactory to learn, from a recent statement by the President of the Board of Trade, in reply to a question asked by Major A. G. Church in the House of Commons, that the Government proposes to take steps to prepare a Bill on this subject.

The history of the movement for reform is familiar to readers of NATURE. In October 1928 the British Science Guild published a report comprising a systematic survey of the needs of the situation, with some fifty or sixty recommendations, large and small. This was widely circulated among persons interested in the subject, and was canvassed, criticised, and mainly endorsed, in reports afterwards issued by various authoritative bodies, notably the General Council of the Bar, a joint committee representing several chemical associations, and the Chartered Institute of Patent Agents. Eventually, in May 1929, the Government set up, under the chairmanship of Sir Charles Sargant, a departmental committee, which issued its report in May last. Since the latter will presumably form the foundation of any legislation that may be introduced, a brief notice of its contents may be of interest.

The Sargant Committee appears to have used the British Science Guild's report largely as the basis of its agenda, and its conclusions, though marked in a certain degree by timidity and conservatism, are in general consistent with the policy put forward by the Guild. There can be little doubt that general support will be forthcoming for legislation on the lines proposed, if the Sargant Committee's recommendations be taken as the minimum rather than the maximum that is expected of the legislature.

The Guild's proposals were somewhat numerous. Among the more important may be mentioned the extension of the scope of the official investigation as to the novelty of inventions; extension of the

* Board of Trade. Report of the Departmental Committee on the Patents and Designs Acts and Practice of the Patent Office. (Cmd. 3829.) Pp. 104. (London: H.M. Stationery Office, 1931.) 1s. 6d. net.

judicial functions of the Comptroller of the Patent Office; a change in the tribunal for appeals from the Comptroller's decisions; strengthening of the law relating to unwarranted threats of patent litigation; and the institution of a system of cheap short-term patents of narrow scope, analogous to the German *Gebrauchsmuster*. The Sargant Committee rejected the last of these proposals outright, for reasons which are stated fairly and at some length in its report. The evidence tendered before the Committee was rather evenly divided for and against the proposal, and the decision is probably right. Short-term patents would bring advantage to some sections of the community and disadvantage to others, and legislation on such a complicated and uncertain subject would not be justified unless an overwhelming demand for it had followed the British Science Guild's report. Such a demand has not arisen. In view, however, of the German practice, it is well that this proposal should have been thoroughly thrashed out.

As regards the proposed extension of the Comptroller's jurisdiction, the members of the Sargant Committee were divided among themselves. The object of the British Science Guild's suggestion on this head was to provide a way out of the impasse which arises from the high cost of patent litigation and the difficulty of obtaining a suitable arbitrator in many patent disputes. In effect, only the wealthiest corporations can afford to enforce their patent rights or to defend themselves against an action for infringement; for such actions have to be tried in the High Court with the assistance of expensive expert witnesses and of counsel who are capable of dealing with scientific technicalities: thus, for the great majority of those who are entitled to justice in connexion with patents, justice is inaccessible on account of its high cost.

The British Science Guild proposed, as a partial solution of this difficulty, that the Comptroller of the Patent Office should be authorised to deal with infringement actions by consent of the parties. This proposal, together with modifications of it, was rejected by the majority of the Sargant Committee; but although a minority report was not formally appended, the fact is mentioned that "a substantial minority has been so impressed with the desire and the need for providing some less costly method of settling disputes relating to patents that it would like a trial to be made of an extension of the jurisdiction of the Comptroller for this purpose". The reasons underlying the opinion of the progressive minority are convincingly stated, while the reasons given for the majority opinion amount in large part to a mere description of prejudices of the kind which are known to be directed against innovations in legal practice. The general question of the high cost of patent litigation is waived, as lying outside the Committee's terms of reference; but for our part, we fail to see why there should be at present no prospect of "the immediate constitution of a special Court to deal with disputes relating to patents and other forms of industrial property, with a view to working out a cheaper and speedier method of trying such disputes". A change in the High Court of that character is undoubtedly desirable and practicable. The majority are content, therefore, to leave without attempted remedy what is probably the most serious of all the defects of the existing patent system in Great Britain.

Appeals from the Comptroller's judicial decisions are at present heard by one of the Law Officers of the Crown, and the British Science Guild recommended that these officers should be replaced by a special judge sitting in chambers. This recommendation was adopted by the Sargant Committee in a slightly modified form. The procedure would be as at present, but a judge selected by the Lord Chancellor would be substituted for the Law Officer.

With regard to the protection of manufacturers against unwarranted threats based on alleged patent rights, the Sargant Committee goes somewhat further than the Guild thought it politic to suggest, and there is clearly a strong case for drastic legislation in the sense of the recommendation made. The effect of this would be that when a person, claiming to possess patent rights without really being entitled to do so, threatens to take legal proceedings for infringement against a manufacturer or his customers, either the manufacturer or his customers would be able to carry through an action against the threatener, so as to get an injunction to restrain him and to recover damages. At present this obviously just proceeding is obstructed by certain legal provisions of a somewhat technical character, the result of which is, in particular, that makers of seasonal goods sometimes lose their market for a year, without remedy, in consequence of threats for which there was no legitimate foundation.

At present the Patent Office examiners make a search among British patents not more than fifty years old, to see how far the inventions that come before them are really new. This restricted search was instituted as an experiment more than a quarter of a century ago, and it is very generally

felt that, since the experiment has yielded satisfactory results, the time is ripe for the system to be carried to its logical completion : that is to say, that the Patent Office search should no longer be restricted to British patent specifications, but should comprise other relevant technical documents. The only obstacle is a financial one, for such an extension of the search would cost a good deal of money. The British Science Guild pointed out that the necessary funds are already available in the excess of fees taken every year from the pockets of inventors and used as revenue by the Exchequer, which adopts this singular method of encouraging the inventions on which the progress of industry depends.

The annual surplus of the Patent Office budget is steadily increasing, and for the year 1930 amounted to no less than £154,545. There are indications in the report that the Sargant Committee was sensitive to Treasury opinion in dealing with this subject ; for while the members declare in paragraph 404 that "the subject matter referred to them is an essentially technical one, and questions of finance lie outside its proper limits", the Committee does not dare in paragraph 47 to recommend any extension of the search that would cost more than £60,000 per annum, and even of this sum two-thirds is to be raised by an increase in the fees paid by inventors. Reading between the lines, one can guess that if the matter had been decided on technical considerations alone, without reference to financial restrictions, the Committee's recommendations would have gone considerably further. But in these hard times we must be thankful that the Committee had even that much courage, and the somewhat parsimonious improvement recommended by it will at least be a step in the right direction.

The report contains a number of minor recommendations, which are generally in harmony with the recommendations of the British Science Guild and will, if adopted, enable the patent system to work more smoothly. It discusses also two important questions which were brought before it not by the Guild but by the Joint Chemical Committee and the Patent Office. The first of these was the 'dedicated patent' scheme. This was intended to take account of a tradition held by the medical profession to the effect that, while it is legitimate to accept fees for administering new drugs, it is illegitimate to accept patent royalties for inventing them. In an attempt to reconcile this tradition with the interests of chemical research and invention, the Joint Chemical Committee suggested that medical patents should be compulsorily dedicated to the public and administered by a State department, which should allocate a fair profit to the patentees. The medical profession, after some wavering, showed itself hostile to this scheme, and the Sargant Committee, while reporting adversely upon it, evinced a feeling that medical inventions may quite legitimately be patented in the ordinary way.

The other important new point was somewhat technical, and related to Section 32A of the Patents Acts. Briefly, it may be said that prior to 1919 the invalidity of a single one of the claims which define the scope of a patent was enough to damn the whole patent ; but the Act of 1919, in remedying this hardship, made way for an abuse by removing the danger which a patentee had incurred if, in defining the scope of his monopoly, he had tried to cast his net unreasonably wide and to claim more than he had really invented. As a result, there has grown up a bad practice of using unconscionably wide verbal formulæ in patent claims, and the Sargant Committee proposes that this abuse should be checked.

The findings of the Sargant Committee represent the irreducible minimum of reform that will content those who desire to bring the British patent system up to date. The chief danger is that the technical character of the whole subject may blind the public and the legislature to its importance, particularly when parliamentary time is subject to such keen competition on behalf of controversial and party legislation.

Hamilton's 'Characteristic Function'.

The Mathematical Papers of Sir William Rowan Hamilton. Vol. 1 : *Geometrical Optics.* Edited for the Royal Irish Academy by Prof. A. W. Conway and Prof. J. L. Synge. (Cunningham Memoir No. 13.) Pp. xxvii + 534. (Cambridge : At the University Press, 1931.) 50*s.* net.

THE publication of the mathematical papers of Sir William Rowan Hamilton, to whom no one will deny the title of greatest of Irish mathematicians, is a notable event. This is the first of the four volumes which are expected to be published, and the only regret that its appearance can arouse is that it did not appear until sixty-five years after Hamilton's death and more than a hundred years after some of its contents were written.

Hamilton's name is known to most students in connexion with the general equations of dynamics

and more particularly to students of quantum and wave mechanics, and there are probably comparatively few but the specialists who realise what a remarkable man he was, or that his dynamical theorems were a development of his work in geometrical optics.

The volume before us opens with an *éloge* delivered by the president of the Royal Irish Academy, the Very Reverend Charles Graves, in 1865, shortly after Hamilton's death. This gives an interesting review of the life and work of a man of very great distinction. To quote one passage only, it is said that "he was to the last degree solicitous about the metaphysics of every subject on which he undertook to write . . . this was in accordance with his views regarding the ascending scale of the subjects of human thought. To religion he gave the highest place, and this not as a formality; for his was a deeply reverential spirit. He assigned the next to metaphysics. To them he subordinated mathematics and poetry, and assigned the lowest place to physics and general literature." His literary attainments were of a high order and he was on terms of friendship with Wordsworth, Southey, Coleridge, and many other distinguished writers of his time.

The present volume is a monument to Hamilton's powers as a mathematician and the vast amount of his original work. We learn from it that the number of his note-books in the library of Trinity College exceeds two hundred, in addition to unbound manuscripts; that they "contain memoirs on a variety of subjects, complete in themselves, and carefully elaborated . . .", and the author of the *éloge* expressed the hope that they will yet see the light. Of Hamilton's youth, he records that he was born in 1805 and entrusted at the age of three to the care of his uncle, the Rev. James Hamilton, of Trim, under whom he studied until he entered Trinity College in 1823; that he communicated his first paper, "On Caustics", to the Royal Irish Academy in 1824; and that while still an undergraduate of twenty-one he was elected to be professor of astronomy in the University of Dublin and Royal Astronomer of Ireland.

With our curiosity further aroused by the fact that by the time he was twenty, this young man had added the "Characteristic Function" to the sum of human knowledge, we turned to his biography (by the Rev. R. P. Graves, 3 vols., 1882 . . .), there to learn something of the early education which had made such developments possible. His uncle was a schoolmaster, and a very capable one. By the time he was four and a half years old, the child was reading Latin, Greek, and Hebrew; at eight he had added French and Italian, and before he was ten he was working at Persian, Arabic, and Sanskrit and reciting Dryden, Collins, Milton, and Homer. At eleven he compiled a Syriac grammar; and withal he was a very human boy, swimming with his uncle, 'riding the ass', and 'making small pits for the workmen to fall into'. It was no doubt an advantage that he acquired a zest for languages before beginning the study of mathematics, for though he carried on his classical studies as an undergraduate and won prizes for English verse and the highest distinction in Greek, yet if mathematics had caught him earlier he might have missed some of that love of literature which was to be a permanent enjoyment throughout his life.

Hamilton appears to have begun Euclid and algebra at about ten; at fourteen he was studying optics and astronomy, and making observations of eclipses and occultations on his own account. A little later he was at work on Newton's "Principia", Garnier's "Differential Calculus", and the "Mécanique céleste" of Laplace; and at seventeen he asserted that he would "rather have the fame of Archimedes than of his conqueror Marcellus or than any of those learned commentators on the classics, whose highest ambition was to be familiar with the thoughts of other men", and began forthwith to write a paper on "Systems of right lines in a plane"; a paper which, as he said many years later, contained the germ of his investigation respecting systems of rays.

At eighteen, Hamilton entered the University, and within a year he had a paper ready for publication. Its title was "On Caustics", and it is printed for the first time in the volume before us. It is a remarkable production for a boy in his teens. It deals with the properties of a general rectilinear congruence without special reference to optics and with no reference to the characteristic function. The editors note an error—a cusp-locus mistaken for a singular solution, an error which Lagrange also appears to have made—and they elucidate it at length in an appendix. The paper was presented to the R.I.A., but was not published. The referees, though impressed by its novelty and by the analytical skill displayed in it, were cautious, and in a friendly report asked for the analytical processes to be more fully developed before publication.

Hamilton continued his investigations on a more definitely optical basis and in the next two years produced a new paper, greatly enlarged in scope, which was presented to the Academy

under the title "Theory of Systems of Rays" and published in 1827. This paper with its three supplements fills more than half of the present volume and is of itself sufficient to establish Hamilton's fame as a mathematician. The 'characteristic function' is introduced at an early stage and at once becomes the basis of the theory. The first part of the paper deals with ordinary systems of reflected rays, and the second part in a similar way with refractions. The geometry of the general normal congruence is extensively developed and there are lengthy discussions of aberrations and of the density of reflected light. The second part concludes with the application of the calculus of variations to the characteristic function to deduce the path of a ray in a medium of continually varying density. This second part of the paper is now printed for the first time.

The "First Supplement" (1830) introduces us somewhat abruptly to Hamilton's function W applied to straight rays in a homogeneous medium. It is a function of the direction cosines of the final ray, whose form is determined by that of the characteristic function V considered as a function of the co-ordinates of a point on the ray. In a useful appendix the editors direct attention to further aspects of the function W, in particular in relation to tangential co-ordinates.

The "Second Supplement" (1830) shows that W (an arbitrary function of the direction cosines of the final ray) furnishes a general integral of the differential equation

$$\left(\frac{\partial V}{\partial x}\right)^2+\left(\frac{\partial V}{\partial y}\right)^2+\left(\frac{\partial V}{\partial z}\right)^2=\mu^2$$

satisfied by V in an assigned medium; and introduces a further function U, a modified characteristic function which was used by Lord Rayleigh in his paper on "Hamilton's Principle and the Five Aberrations of Von Seidel" (1908).

The "Third Supplement" (1832) represents a great advance. It is a generalisation and extension of the previous work to include the case of heterogeneous and anisotropic media. It includes variations of the initial as well as of the final elements of the ray, and adds a term to the characteristic function to provide for variations in colour. It introduces the second auxiliary function T, applies the methods to the wave theory as well as to the emission theory, and contains the remarkable theoretical discovery of *conical refraction*.

Part II. of the volume contains, in some fifty pages, reprints of ten minor papers dating from 1832 to 1841, all of which are of interest, particularly so a British Association Report "On the Characteristic Function in Optics". Part III., "Manuscripts", consists of papers not hitherto published, including the original paper "On Caustics" and a lengthy paper "On the Improvement of the Double Achromatic Object Glass".

In addition to Hamilton's papers, the book also contains an excellent introduction, which traces the development of the characteristic function as it gains in generality and power through the various papers that follow, and sums up Hamilton's achievement in the general theory of geometrical optics. The editors also direct attention to the value of Hamilton's work from the purely geometrical point of view, and indicate that Kummer, who is often regarded as the founder of the theory of the general rectilinear congruence, was careful to give full credit to the work of Hamilton; they also remark that Hamilton not only developed the theory of the congruence in his paper "On Caustics" but even attacked its singularities. The introduction to the book also contains a brief summary of the contents of all the papers that follow.

The volume closes with some fifty pages of "Editors' Appendix", containing historical notes and references and notes explanatory of difficulties in the text, where the argument is unnecessarily prolix or where it needs amplification. Indications of the relation of Hamilton's work to modern mathematics are also given. This is a very valuable part of the volume. It affords evidence of the thoroughness and the great amount of care that the editors have expended on the work, and is deserving of the gratitude of all students of the subject and, indeed, of all who desire to see Hamilton's papers published in a form befitting their merit and the greatness of their author. There is no gainsaying the fact that though Hamilton's style is lucid and attractive, his ideas are not always easy to follow to their conclusions, and, to quote the editors, "the application of his methods to the optical instrument of revolution was for long the despair of mathematicians". There is little enough of application of the theory to be found in the papers, and it is a matter for regret that Hamilton did not complete the book to which he refers in a letter of 1841 (quoted in his biography): "I am seriously thinking of publishing after some months a treatise on Optical Systems of Rays, for University men and others of that class, and have several times recomposed the first mathematical chapter. . . . My object will be to make better known my method, and especially to show that it *is* a *method*,

an *instrument* of demonstration and research." The book was never published, and it would be of interest to know whether the manuscript is among the many in the library at Trinity College, Dublin.

It is curious that while Hamilton's work on optics was well known in Great Britain and the use of the characteristic function in optics was the subject of a number of papers by Maxwell and others, it remained almost unknown in Germany for the best part of a century. In 1895 a paper, "Das Eikonal", was published by H. Bruns announcing his discovery of the characteristic functions for homogeneous isotropic media, naming them the Eikonal, and making what was in the circumstances a singular claim, that the Eikonal which he had discovered plays, in the narrower region of geometrical optics, a similar rôle to that of Hamilton's theorem in mechanics. The theory of the Eikonal was more fully developed by Schwarzschild in 1905 and has been used by several modern writers. But the editors direct attention to the valuable appreciation and review of Hamilton's published papers on geometrical optics in two papers by G. Prange in 1923, and to the 1924 edition of Czapski-Eppenstein, "Grundzüge der Theorie der optischen Instrumente", in which, for the first time, the work of Hamilton has received adequate notice in a compendious textbook.

In conclusion, the editors are to be congratulated on the publication of so much of Hamilton's work in so attractive a form, and on the production of a volume which reflects so well the care they have bestowed upon it.

In the printing of the book, the standard of excellence associated with the Cambridge University Press is well maintained.

A. S. RAMSEY.

Soviet Science.

Science at the Cross Roads. Papers presented to the International Congress of the History of Science and Technology held in London from June 20 to July 3, 1931, by the Delegates of the U.S.S.R. Pp. iv + 23 + 4 + 24 + 12 + 12 + 10 + 4 + 31 + 62 + 15 + 3. (London: Kniga (England), Ltd., 1931.) 10*s.* 6*d.*

THE file of black-bearded men who marched across the room at South Kensington at the opening meeting of the recent International Congress of the History of Science was one of its most striking features. They were delegates from Russia and had arrived from Moscow by aeroplane. It was the largest deputation which appeared together at that reception from any country except the United States. Finding later that no one speaker could be allowed more than ten minutes to develop his subject, they decided to have their speeches printed and published in London, and this was done in what is probably the record time for a volume bound in cloth and lettered in gold. It appeared on the seventh day after they had handed their manuscripts to the printers, and it was reviewed in at least one weekly journal two days after. The story is typical of the feverish speed with which the work of reconstruction is going on in present-day Russia, and one can only hope that what is being done in such haste will not be repented at leisure by the masses who are undergoing the process.

The book before us will be read with mingled feelings, sometimes of admiration for the grandiose ideas and the energy with which they are being applied in virgin soil, often with puzzlement as to the meaning of certain abstract phrases which are constantly used in connexion with well-known facts in the evolution of science, often again with irritation at the ceaseless repetition of catchwords which no fair-minded student can think have any real bearing on the subject under discussion. The last class of instances will probably be most obvious to the average English reader and can be dealt with most easily. The essays refer constantly to "bourgeoise" science and "science in capitalist societies" and the revolution to be effected in science by "dialectical materialism". Throughout there is the implication that science before the Russian Revolution, even if not entirely due to capitalist contrivance, had certainly been used for capitalist ends.

On this point a clear and simple distinction may be made. So far and so long as industry is in the hands of private producers, the discoveries of science will be used by those persons for the improvement of their processes. The first effect, if the science is sound and the applications practicable, will be to increase their profits, though the advantage will be gradually distributed throughout society according to the economic and moral relations existent in it. Hence, no doubt, the primary result of the applications of science in the nineteenth century was the creation of a large comfortable middle-class, based on scientifically organised industry. But this development is immediately followed by a diffusion of the gains—through social reform, cheaper prices, trades unionism, etc.—among society as a whole. We therefore have at the present time, in all the most

fully industrialised countries of the West, a population largely and demonstrably better off than they were before the Industrial Revolution. Whether the Russian method will in the end secure the same, or even superior, results remains to be seen; up to the present it certainly has not.

When we come to speak of science in itself, that is, the systematised and tested knowledge of the world we live in, the attempted distinction between a 'bourgeoise' and a 'socialist' science is irrelevant and absurd. The laws of Nature are the same for all of us, and they have been built up by the co-operating efforts of men of all nations, classes, and opinions. No one, in all the millennia which have seen this process going on, has ever before suggested that there was one type of truth about Nature produced by, and useful to, those in a privileged position in society, and quite another type to be revealed to those who approach it under the orders of a socialist government. Such a government might indeed make better use of the gifts bestowed by science than have certain governments in the past, but it could not discover different laws. It might by generous encouragement lead its subjects to build up the fabric of science more quickly. If Russia does this, all the world will be her debtor, just as she is in debt to all the past and all the nations—'capitalist' or otherwise—who have given her, and are still giving, the fruits of science which she enjoys.

The slogan which is thus dinned into our ears is, of course, of political origin and derives from the fundamental statute of the Russian universities under the Soviet Government. This lays down that "The Academy has to contribute to work out a unique scientific method on the basis of a materialistic world view, directing the whole system of scientific knowledge toward answering the needs of social reconstruction". Here again we must distinguish the element of truth from the large and dangerous fallacy. It is well to make more prominent than the past has done the need of reconstructing society on a scientific basis; it is fatal to attempt to limit the free use of their powers by those who have to lay the theoretical foundations.

Of the papers submitted to the Congress, the most interesting and learned is that by Bukharin, director of the Industrial Research Department of the Supreme Economic Council. His reading is immense and varied, and he uses it to illustrate his two main theses. The first is that all knowledge is a social product and is inseparably connected with practice, "for every man experience, representing the result of the influence of the external world on the knowing subject in the process of his practice, stands on the shoulders of the experience of other people. In his 'I' there is always contained 'we'." This is all excellent and clear. The latter part of his paper is less so, for it involves that identification of the movement of scientific opinion with social revolution which is continually repeated as 'dialectical materialism'. This is the crude legacy which Marx inherited, or claimed to inherit, from Hegel, and it lies heavy on the shoulders of these men who are striving, many of them with genuine and disinterested enthusiasm, to make a success of their experiment and raise the lot of the millions of Russia.

Of the remaining papers, two will attract most attention and add something notable for our information or inquiry. One is the paper by Vavilov, president of the Lenin Academy of Agricultural Sciences. It gives, in summary form, the results of inquiries carried out in different parts of the world as to the origins of agriculture. Expeditions have been sent out and results tabulated as to seven or eight primary agricultural centres, both in the Old World and the New. Great stress is laid on Abyssinia, and some curious and valuable facts appear to have been discovered there as to the early cultivation of wheat, flax, barley, and coffee. Vavilov concludes that Egypt borrowed its crop plants largely from Abyssinia, and that the primary agricultural centres generally are in tropical and sub-tropical mountain regions.

The other paper which will lead to further inquiry is that of Prof. M. Rubinstein on the recent development of institutions for scientific research. Of these there has been a large increase, especially in the last few years. In 1930 there were 72 scientific research institutes, with 83 branches, as against 24 with 8 branches in 1928, with thousands of factory laboratories, and a personnel of 'workers' given as 40,000 and students (in 1931) as 157,000.

It is evidence of amazing zeal and energy, whatever may be the quality or permanence of the work. Our visitors, and those who sent them, should rest assured that we have in Great Britain nothing but goodwill for all genuine efforts to advance knowledge and spread its beneficent results over the widest area. We plead only for that tolerance and goodwill which are ready to recognise similar merits, wherever they may be found and under whatever government. For science, being the common offspring, should be the common link of all mankind.

F. S. MARVIN.

Aeroplane Survey of Peru.

Peru from the Air. By Lieut. George R. Johnson. With Text and Notes by Raye R. Platt. (Special Publication No. 12). Pp. xii + 159. (New York: American Geographical Society, 1930.) 5 dollars.

THE value of aeroplane photography and surveying has been well demonstrated in archæology and forestry, and its special service to the geography of rugged and waterless countries is illustrated by the volume of photographs of Peru, taken by Lieut. G. R. Johnson, when chief photographer to the Peruvian Naval Air Service, and issued by the American Geographical Society. The volume includes 150 well-selected photographs, each 8½ in. by 6½ in., and six sketch maps. It has an excellent introduction by R. R. Platt, head of the Department of Hispanic-American Research of that Society.

The geographical structure of Peru is still inadequately known, owing to the difficulties imposed by the waterless nature of most of the coastal plain and the almost chronic rains and the labyrinth of deep and densely forest-clad valleys in the Eastern Andes. It consists of three geographical units: the coastal belt, the Andes, and the upper valleys of the Amazon. The essential structure of each of them is still imperfectly known or has been, until recently, misunderstood. The Andes form the backbone of the country and they were regarded as composed of two fold-mountain chains separated by the great basin which contains Lake Titicaca. The Western Cordillera have been found to be a high plateau, of which the surface is a peneplane cut across the folded strata; the western front is dissected by profound canyons, the irrigated floors of which include the most productive areas in Peru. Some of these valleys are continued across the coastal belt and their crops of cotton and sugar are exported from the thirty ports that occur isolated in the coastal desert. The southern coast is bordered by an ancient mountain chain which has been called by Steinmann the Chimu-Andes.

As the photographic survey was conducted by the Peruvian Naval Department, the coastal belt is naturally the best illustrated, with numerous views of the deeply indented northern coast, the guano-capped islets and peninsulas, the ports and the valleys they serve, and the dunes and deserts that sever overland communication along the coast. The peneplane of the Western Andes is graphically portrayed and there are striking photographs of the lofty extinct volcanoes that rest upon it.

The eastern valleys are relatively neglected. The illustrations are of the riverside hamlets and the hydroplane stations on the upper tributaries of the Amazon. They show that the development of eastern Peru has made less progress than might be inferred from the ordinary maps. The volume does not illustrate the structure of the Eastern Andes, as it does that of the coastal belt. The nature of the front of the Andes above the Amazon is uncertain: it has been often regarded as a dissected fault scarp, but that view is denied by Dr. Bowman. A series of aeroplane photographs of the area might afford the easiest solution of this problem, but the few views of the Eastern Andes were selected to illustrate the settlements in the valleys and not the genetic structure of the country. The volume will be a most useful companion with current literature on Peruvian geography.

Short Reviews.

Contributions to Marine Biology: Lectures and Symposia given at the Hopkins Marine Station, December 20–21, 1929, at the Midwinter Meeting of the Western Society of Naturalists. Pp. viii + 277. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1930.) 35*s.* net.

THE growth of marine stations on the Pacific coast of the United States has induced much experimental research on the biology of organisms and the nature of their environment. The Western Society of Naturalists has instituted mid-winter meetings where this is discussed, and the present volume contains 23 papers presented in 1929. They commence with a most thoughtful lecture by C. A. Kofoid on the "Evolution of the Tintinnoinea", a group of pelagic ciliates, which he has monographed. They possess an external chitinoid shell, formed perhaps by both daughter cells after fission. The species in a genus are characterised by increase in size, duplication of structural features, elongation, and differentiation of surface pattern. Undigested fæcal residues may be built into the shells, and there is a beautiful picture of the utilisation of coccoliths for this purpose. The known species in polar waters is 101 and in the tropics 515, which approximates to the requirements of Van 't Hoff's law. It is suggested that solar radiation is the one outstanding factor capable of inciting genetic change in these animals. Another lecture was given by T. Wayland Vaughan on "The Oceanographic Point of View". Then follow 21 papers divided into oceanography, permeability, photosynthesis, early development, marine Algæ and growth.

We admire the quality and keenness of the writers, while in some cases desiring that the research had been further extended before publication. We are pleased to see researches on the living green and brown Algæ from Stanford and Seattle Universities, and a thoughtful article by A. R. Moore, in which it is claimed that cell-bridges are

necessary to account for the arrangement of the cells in the formation of blastula and gastrula. As general propositions, not necessarily applied to the papers in this volume, we suggest that no research be published without an adequate summary, and that an author is not entitled to cite any literature which he has not personally consulted without stating this fact.

Outlines of Palæontology. By Prof. H. H. Swinnerton. Second edition. Pp. xii + 420. (London: Edward Arnold and Co., 1930.) 21*s.* net.

IT is a good sign that a second edition of this excellent book should be called for after seven years, a period which for text-books of this rather special character must be regarded as short. For this is far removed from the ordinary manual. It is no mere summary of either facts or theories. While it does not ignore facts, it bases on them a succession of thoughts that breed thought in the reader. Prof. Swinnerton has not compiled facts, he has assimilated them, and every page bears the mark of an original thinker.

While welcoming a second edition, we feel it our duty to say that the revision has not been so extensive as to provoke any student to exchange old lamps for new. Several obvious misprints have been corrected, but others only partially or not at all. *Saccemina*, for example, has had the *e* changed to *a*, but does not yet attain the perfection of *Saccammina*. Some erroneous or inexact statements of the first edition have been modified, but not always quite successfully, and this clearly has arisen from a desire not to alter the standing type or stereo-plates more than was necessary. Thus, on p. 141, there is an ingeniously contrived improvement in the account of the crinoid centrodorsal, but the distinction between that structure and the proximale is still incorrectly given. Several statements or expressions that we should like to have seen altered, remain as they were. Prof. Swinnerton is entitled to his own opinion; but some of them are more of fact than interpretation. Among these, the diagram showing the relative abundance of the echinoderm classes in time certainly should have been re-drawn to-day, whatever may have been thought of it in 1923. Let us hope for a third edition in 1937. F. A. B.

Chemistry for Matriculation. By Dr. G. H. Bailey and H. W. Bausor. Third edition. Pp. viii + 448. (London: University Tutorial Press, Ltd., 1931.) 7*s.* 6*d.*

THE aim of this class-book is to present a clear account of the essential principles and phenomena of elementary chemistry. The subject is divided into three sections. Section 1 is of an introductory nature. The earlier chapters are concerned with the study of such common substances as air, water, chalk, and the acids, bases, and salts. In the later chapters of this part, the fundamental principles and theories are deduced and outlined. This section concludes with a description of the phenomena of electrolysis and with chemical calculations. Section 2 consists of a lengthy systematic treatment of the non-metals and their more important compounds, whilst Section 3 deals similarly (but more briefly) with some of the metals.

The authors have endeavoured to keep the treatment of the subject as practical as possible, and have introduced many simple experiments to illustrate the facts and support the general theories of the science. Sufficient details are generally given to enable the student to carry out the experiments unaided. Compared with previous editions, the subject matter of the book has undergone considerable revision and rearrangement, whilst additional information has been given, especially in connexion with industrial practice. Opinions differ concerning the most suitable methods of treating elementary chemistry; but as a text-book for candidates reading for university matriculation examinations, Bailey and Bausor's volume attains its object.

Aus der Medizin des Rinascimento. An der Hand des "Leben von Benvenuto Cellini" nach der übersetzung Goethes. Von Prof. Dr. Paul Strassmann. Pp. 56. (Leipzig: Georg Thieme, 1930.) 13 gold marks.

THIS fine volume contains a commentary on the passages in Goethe's translation of Cellini's autobiography which throw light on the medicine of the Renaissance. The close relationship between the artists and anatomists of the period, of which Leonardo da Vinci offers the best-known example, is well illustrated by Cellini, who counted among his friends Guido Guidi, otherwise known as Vidus Vidius, of Florence, and Berengario da Carpi, of Bologna, who, in addition to being highly skilled surgeons, made valuable contributions to anatomy.

Several pages are devoted to a consideration of Cellini's illnesses, which included malaria, from which he suffered on several occasions; brass founders' ague, contracted while he was engaged on the statue of Perseus at Florence; a protracted fever, accompanied by delirium, which may have been typhoid; and a disease regarded by some authorities as syphilis, though this view is discredited by Strassmann; as well as an almost fatal attack of arsenical poisoning. The other points of medical interest discussed in this book are the prevalence during the Renaissance of syphilis, prostitution, and homosexual practices; the high incidence of illegitimacy, the position of contemporary obstetrics, and the high maternal and infantile mortality.

The text is interspersed with numerous excellent illustrations relating to Cellini and the medical life of his age.

The Human Body. By Dr. Logan Clendening. Second revised edition. Pp. xiv + 399. (London and New York: Alfred A. Knopf, 1931.) 10*s.* 6*d.*

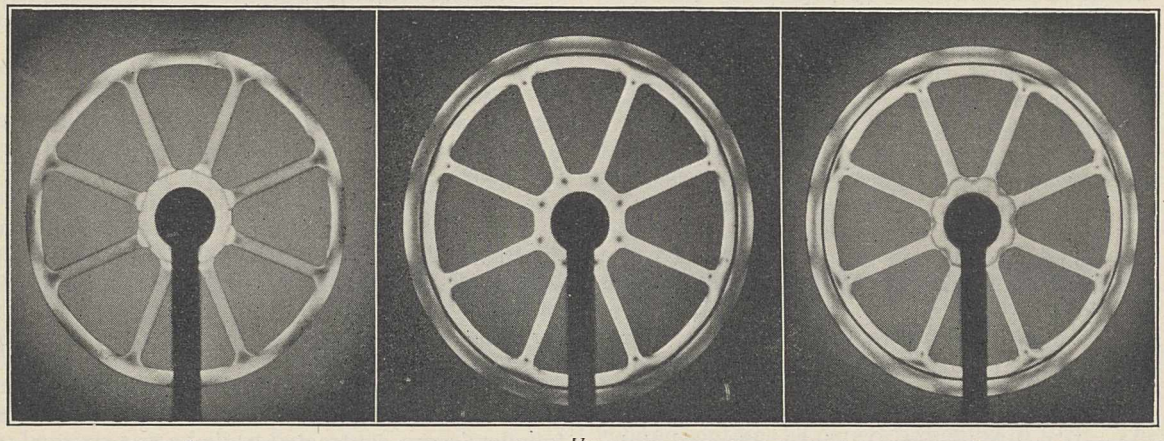
IT is refreshing to meet a book like this, which is at one and the same time enlightening and entertaining. It contains a fund of common sense, and the passages on dyspepsia and constipation ought not to be missed by present-day food faddists. It represents a pleasant means of obtaining much information about the inner workings of the body.

Stresses in Wheels.

By Prof. E. G. COKER, F.R.S.

THE stresses imposed on wheels during construction are usually not inconsiderable, and the loads, borne by them later, add greatly to the stress intensities. Although wheels are in universal use, comparatively little appears to be known of the stress distributions in them, although long practical experience has enabled constructors to satisfy exacting modern conditions.

In the vast majority of cases a wheel is built up with a central hub connected by spokes to a circular rim, a combination usually known as a wheel centre, on which is secured an outer tyre. Until the bicycle era, spokes were almost always in compression, and the invention of the wired wheel with all spokes under considerable tension was a notable advance in construction for light vehicles.



a *b* *c*

FIG. 1.—*a*: Wheel centre stressed by an axle forced into the hub. *b*: Stress distribution in a tyre and wheel centre before the axle is forced in. *c*: Stress distribution in a completed wheel.

Modern conditions, however, appear to favour the use of the older form for all heavy traffic, with a well-marked difference between wheels for road and rail vehicles, in that for the former the wheel almost invariably revolves on a fixed axle, while for the latter the axle is secured to the wheel and revolves with it.

The determination of the stress distribution in any form of built-up spoked wheel is difficult, either by analysis or experimental means. It has, however, become a matter of some urgency to know accurately what are the maximum stresses in wheels for very heavy duties such, for example, as occur in present-day railway practice.

With the object of showing the general nature of the stresses produced in construction, a simple illustration is chosen of a railway wagon wheel, consisting of a wheel centre of the form shown in the photograph (Fig. 1, *a*), having eight spokes connecting the central hub with the rim, into which an axle is forced and an outer tyre is shrunk on. Into the hub of this model wheel centre, which is constructed of transparent material to a scale of one-twelfth full size, an axle has been forced, but this latter is not seen owing to the vertical stand used for photography, although the stress distribution it causes in the wheel centre is made visible by a beam of circularly polarised light. The photograph shows great stress intensity in the hub and very little in the spokes, except where they join the hub, while at the outer rim the stress, although of small intensity, is of such a nature that the rim experiences a maximum stress at its outer edge opposite to a spoke, and another maximum stress at its inner edge at places midway between adjacent spokes. The chief feature of interest, however, is at the contact surface between the axle and the hub, where the isochromatics show, and the measurements confirm, that the radial pressure P (Fig. 2, *a*) is variable round the axle with maximum values at the spokes, so that this pressure waxes and wanes in the manner shown. In the hub, however, the circumferential tension Q at the axle reaches a minimum value opposite a spoke with only slightly greater values between.

If, instead of forcing an axle into a wheel centre, a tyre is shrunk on first, some interesting features are observed in the wheel centre, due to two separate groups of principal stress differences of zero value, and shown in the photograph (Fig. 1, *b*) by symmetrically placed black dots, one set in the hub and the other in the spokes near their junctions with the rim.

These stress effects, due to the identity in magnitude and sign of the principal stresses, are traced along a spoke in Fig. 2, *b*, where the measured values of the radial stress distribution P, and the corresponding circumferential stress distribution Q, not only confirm the existence of these two groups of stress difference zeros at points A and B, but also show that a third group of low stress intensity exists at points C. The occurrence of this last group is a matter of practical importance, as will appear later.

The principal feature, however, is the high stress intensity in the tyre, which, over a spoke, has a maximum intensity at its outer edge, and a minimum at the inner edge, as shown in Fig. 2, *b*, while midway between the spokes this state of stress is reversed, as we then find a maximum stress at the inner edge with a corresponding minimum at the outer circumference.

In railway work it is the usual practice to force the axle into the wheel centre first, and then shrink on the tyre. When this is accomplished, a stress distribution is found of the kind shown in the photograph (Fig. 1, *c*), in which both the hub and the tyre are highly stressed, while the spokes are still to exert great tractive force at the rails, it is found necessary to fasten the tyres more securely to the rim of the wheel centre by additional devices, in order to prevent circumferential slipping.

Formerly it was the practice to screw radial studs *D* (Fig. 2, *c*) through the rim of the wheel centre and into the tyre at places midway between the spokes, as indicated here, thereby making holes in the tyre at places where the stress is already intense, and therefore adding to it very greatly, owing partly to the lessened cross-section of the tyre, and also to the effect of the discontinuity, necessitating changes of direction of the tensional stress in passing round the hole so formed. This practice

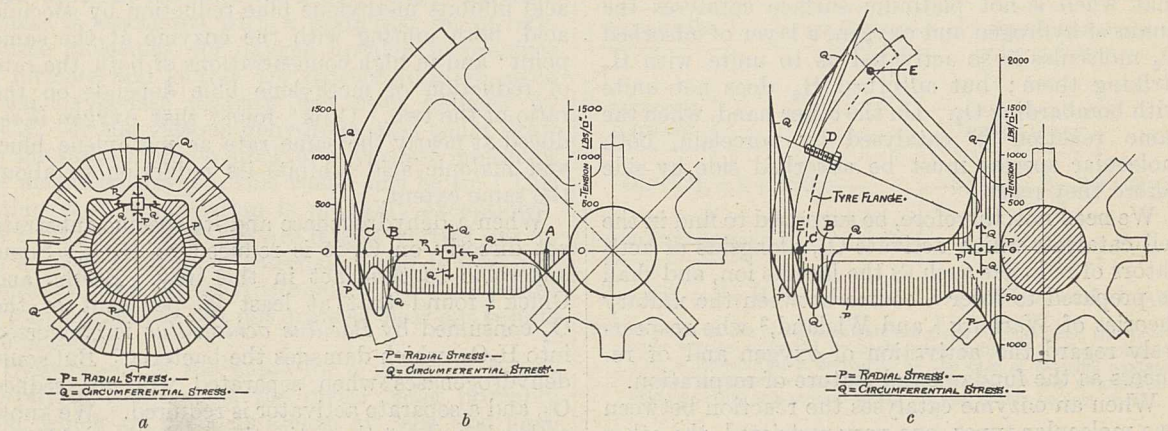


FIG. 2.—*a*: Stress distribution in the hub of a wheel at the axle, when the latter is forced on. *b*: Stress distribution in a wheel, along the line of a spoke, when a tyre is forced on to a wheel centre. *c*: Stress distribution in a wheel when the axle has been forced into the wheel centre and the tyre shrunk on.

only moderately loaded. As will be noticed here, the two outer groups of stress difference zeros are still present, although in slightly different positions radially. This is seen more clearly in Fig. 2, *c*, where the measured principal stresses *P* and *Q* are shown with reference to a radial plane through the centre of a spoke.

These distribution curves also show that the combined effect of both axle and tyre is to increase the radial stress on the axle greatly. In the tyre, increased stress is also apparent, although it remains of the type already described with reference to Figs. 1, *b*, and 2, *b*. This latter distribution is more particularly interesting in its application to much larger wheels, such as the driving wheels of locomotives, where, on account of their size and the necessity of supporting the tyre at short intervals, the number of spokes is much increased, and since, unlike wagon wheels, they are required has now been given up in favour of transverse rivets *E* inserted in holes made in the wheel centre rim, very close to the stress difference zeros *C*, and passing through a flange formed on the tyre, which is now constructed to lap over the rim, as indicated by a dotted line in Fig. 2, *c*.

The photoelastic effect shows clearly the advantage of this method of fastening, for the discontinuity now produced by boring a hole at a place near the position of the stress difference zero *C*, where the principal stresses *P* and *Q* are both small, only causes a very moderate increase in both stresses, while no inroad is made into the main cross-section of the tyre. Practical experience has shown that tyres fastened in this way are much stronger and safer than those secured to the wheel centre by the older method, and the advantages of this new form of fastening have secured its very general adoption.

Oxidation by Living Cells.*

By Prof. J. B. S. HALDANE.

UNTIL recently our knowledge of the chemistry of respiration stopped abruptly at the boundary of the cell. We knew how the oxygen was carried to it in vertebrate blood, and the carbon dioxide carried away. We also knew that the rate of oxygen consumption by the body as a whole, and by certain organs, was a function of numerous variables, such as temperature, hydrogen ion concentration, nervous stimulation, and so on. A certain number of partially oxidised metabolites, such as β-hydroxybutyric acid, had been isolated. But such quantitative knowledge as existed with regard to the details of oxidation was mainly confined to reactions in which coloured molecules were

* Substance of lectures delivered at the Royal Institution on Feb. 5, 12, and 19.

involved: for example, the reduction of methylene blue to a colourless substance, or the oxidation of *p*-phenylene-diamine to a coloured one.

The modern period began with the work of Batelli and Stern, and of Bach and Chodat, in Geneva, and since the War the most important centres of research have been the laboratories of Thunberg in Sweden, of Warburg and Wieland in Germany, and of Hopkins in England. This work has led to the recognition of a number of distinct catalysts, each responsible for a different part in the process of respiration. Inorganic catalysts of oxidation may activate the oxidant, the reducer, or both. Thus, Langmuir concluded that when a hot platinum surface catalyses the union of hydrogen and oxygen, a layer of adsorbed O_2 molecules is so activated as to unite with H_2 striking them; but adsorbed H_2 does not unite with bombarding O_2. On the other hand, when the same reaction is catalysed by porcelain, both molecular species must be adsorbed side by side before they react.

We need not, therefore, be surprised to find in the cell catalysts which activate O_2, alongside of activators of reducers such as the lactate ion, and shall be prepared to steer a course between the unitary theories of Warburg [1] and Wieland,[2] who respectively regard the activation of oxygen and of reducers as the fundamental feature of respiration.

When an enzyme catalyses the reaction between two molecular types, one very restricted, the other very general, we describe it as specific for the former. Thus Dixon [3] and Coombs [4] found that xanthine dehydrogenase catalyses the reaction $AH_2 + B = A + BH_2$, where A must be one of a small number of purine bases (it is possible that the same enzyme also activates aldehydes; if so, they are oxidised at about one per cent of the rate of the purines). But B may be oxygen, iodine, nitrate, permanganate, or any of a large number of dyes, such as methylene blue. These latter are perhaps all held on the enzyme surface near the former, but it is difficult to imagine that there is a single molecular grouping responsible for activating all of them. For reaction it is not sufficient that a molecule should be united with the enzyme; it must be activated as well. Thus, uric acid unites with xanthine dehydrogenase at the same spot as xanthine, thus inhibiting its oxidation, but is not oxidised, though another enzyme can accomplish this process.

A large number of dehydrogenases are known which act in a similar manner, each causing the activation of one or more organic substrates. Thus, lactic dehydrogenase, which can be obtained in solution from a number of sources, activates several α-hydroxyacids; succinic dehydrogenase, another enzyme easily obtained in solution, activates succinic and methyl-succinic acids; and so on. The activity of these enzymes is generally measured by the rate at which they catalyse the reduction of methylene blue by their substrates. They usually have a wide range of optimal *p*H from about 7 to 10, instead of a small range like hydrolytic enzymes, and a fairly constant Q_{10} in the neighbourhood of 2, that is, a critical increment of about 12,000 calories. They are not inhibited by small concentrations of cyanide or sulphide, but are so by the usual enzyme poisons, such as heavy metals and nitrites, and oxidising agents. The formic dehydrogenase of *Bacillus coli* appears to be a copper compound, but there is no evidence that most dehydrogenases contain metals. Quastel [5] and his colleagues have made a very thorough study of the dehydrogenases on the surface of *Bacillus coli*. There are probably at least seven different ones, and possibly many more. In this case they can readily be shown to be concerned in oxygen uptakes. In certain conditions malonic acid inhibits methylene blue reduction by succinic acid, both uniting with the enzyme at the same point; and in high concentrations of both, the rate of reduction of methylene blue depends on the ratio of the two. Cook [6] found that oxygen is reduced at nearly the same rate as methylene blue, and malonic acid inhibits its reduction to about the same extent.

When a dehydrogenase and its specific substrate act directly on O_2 it is reduced to H_2O_2. Some anaerobic bacteria act in this way. Bertho and Glück [7] found that at least 90 per cent of the O_2 consumed by *Bacillus acidophilus* is converted into H_2O_2, which damages the bacteria. But some dehydrogenases when separated will not reduce O_2, and a separate activator is required. We know rather less about the activation of O_2 than of H_2O_2. This latter can be activated by two different enzymes, catalase and peroxidase, and by heat-stable peroxidase-like substances such as cytochrome and hæmatins.

Catalase catalyses the reaction $2H_2O_2 = 2H_2O + O_2$. Zeile and Hellström [8] have shown that it is a derivative of hæmatin with a definite spectrum, and convertible into a hæmochromogen, or into protophyrin. It unites with HCN to give an inactive compound. Under suitable conditions a catalase molecule can destroy more than 10^5 H_2O_2 molecules per second. Peroxidase catalyses the reactions $H_2O_2 + X = H_2O + XO$, or $nH_2O_2 + nX = nH_2O + nXO$, where X may be a large variety of molecules, generally aromatic, but including nitrite and HI. It can be very highly concentrated, and appears to be a coloured iron compound. Its extreme sensitivity to cyanide suggests that it is of a similar nature to catalase.

The oxygen activators (oxygenases or *Atmungsferment*) have been specially studied by Warburg.[1] They unite not only with O_2 but also with CO, for which they have a rather smaller affinity. Like CO-hæmoglobins, the CO-oxygenases are generally sensitive to light. Thus the oxygen uptake of yeast in presence of glucose or alcohol is reduced to about 50 per cent, in a mixture containing ten parts of CO to one of O_2, in the dark. In strong light it returns to almost normal values. By studying the relative efficiencies of different monochromatic lights, Warburg and Negelein [9] found that its spectrum is very similar to that of alkaline hæmatin, and still closer to that of iron-phæophorbide-*b*.

Cook, Haldane, and Mapson [10] worked with *B.*

coli in toluene-saturated buffer solutions. Under these conditions, succinic, lactic, and formic acids each lose two hydrogen atoms and no more. It is thus possible to study reactions much simpler than the complete oxidation of a substance such as glucose. They found that CO and HCN, which in moderate amounts do not prevent oxidations by methylene blue, inhibit oxygen reduction. In both cases the oxidation of lactate is more sensitive than that of formate, while that of succinate is intermediate. Hence there appear to be three oxygenases with specific relative affinities for CO and O_2, like those of the hæmoglobins, and also with different affinities for HCN. Each dehydrogenase is associated with a particular set of oxygenase molecules, for oxygen uptakes in presence of formate and lactate are strictly additive, even when oxygenase activity has been reduced by HCN. If the various dehydrogenases could draw on the same common stock of oxygenase molecules for activated oxygen, this would not be so. This rather rigid organisation is probably exceptional, for oxidations by *B. coli* are largely carried out on its surface, instead of internally, and it does not contain all the three cytochromes. In the absence of toluene, similar but not quite so clear-cut results are obtained.

Cytochrome is the name for a group of metal-porphyrin compounds, the metal being probably iron, which are found in almost all cells, and have been studied by Keilin.[11] When the cell runs short of oxygen, through asphyxia, intense metabolism, or cyanide poisoning, a strong spectrum of cytochrome, resembling that of a mixture of hæmochromogens, appears. If the supply of oxygen becomes adequate, the characteristic bands disappear, being replaced by a fainter spectrum of the alkaline hæmatin type. Cytochrome is not oxygenase, as it does not combine readily with CO or HCN. One of the three components of cytochrome, cytochrome *c*, has been obtained in fairly strong solution. It is a red substance, only slowly oxidised by molecular oxygen, readily by mild oxidising agents. It can be reduced by reducing agents or living tissues, and is an iron-porphyrin compound. Keilin found that the oxygen uptake of a system composed of oxygenase from heart muscle, cytochrome, and cysteine behaves like that of a tissue to cyanide and CO. With this system he was able to show that oxygenase is heat-labile like an enzyme, which cytochrome is not. In plants, a particular type of oxygenase, which Keilin calls catechol oxidase, and the CO compound of which, where investigated, has been found to be insensitive to light, yields H_2O_2 when oxidising catechol and its derivatives, as shown by Onslow.[12]

We can thus give a scheme (Fig. 1) which probably covers most of the oxidation process in the average cell. In anaerobes one or more of the catalysts is absent. Oxygen is activated by oxygenase, which is reduced by cytochrome, and the latter is reduced in turn by dehydrogenases of the common or anaerobic type, that is, those which cannot reduce O_2 directly. This process is occasionally simplified, as in *B. coli*, where cytochrome does not seem to intervene in certain oxidations. Oxygen can also be reduced to H_2O_2, either by catechol oxidase or by an aerobic dehydrogenase. This H_2O_2 is used for further oxidation with peroxidase, or is destroyed by catalase. The latter can act as a safety-valve owing to its low affinity. Whereas peroxidase acts most rapidly in a concentration of H_2O_2 which may be as low as 10^{-6} *M.*, catalase has an optimum H_2O_2 concentration of

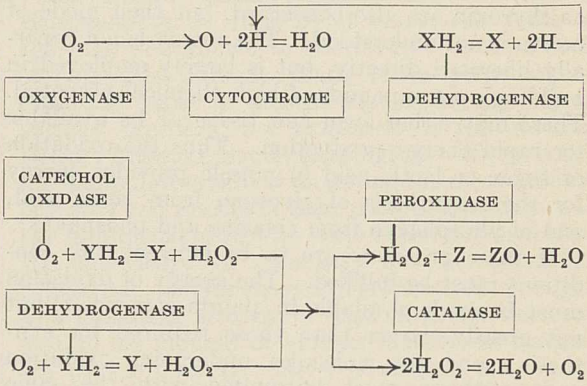


FIG. 1.—The names of the catalysts are given in rectangles, the molecular species activated by each being indicated. The molecule YH_2 is catechol or a derivative in the case of catechol oxidase (Onslow's oxygenase) and is a purine base in the case of xanthine oxidase acting as a reducer of O_2. X and Z may be very varied.

about 0·2 *M.*, and at 10^{-6} *M.* is working at only about 0·0004 of its maximum rate. Other substances may act as intermediates. Glutathione appears to remove hydrogen from certain groupings in proteins, the reduced glutathione being later re-oxidised. St. György's[13] hexuronic acid is apparently reduced by dehydrogenases and oxidised by peroxidase. Doubtless many more similar substances will be discovered in future.

We note the great importance of metal-porphyrin compounds (Table I.). It is fairly clear that their

TABLE I.—METAL-PORPHYRIN IN COMPOUNDS FOUND IN CELLS.

1. Catalysts. Chlorophyll *a* and *b*. Oxygenases. Catalases. Probably peroxidases. Cytochrome *a*, *b*, and *c*.
2. Mainly concerned in oxygen storage. *Arenicola* hæmoglobin.
3. Mainly concerned in oxygen carriage. Vertebrate hæmoglobins.
4. Uncertain whether in group 2 or 3. Many invertebrate hæmoglobins. Chlorocruorin. Helicorubin, etc.

catalytic function is primitive. They have afterwards been modified to act as stores or carriers of oxygen in higher animals. Except in chlorophyll, a magnesium compound, the metal united with the porphyrin is usually, if not always, iron. As oxygenase, catalase, and cytochrome are almost universally distributed, we need not be surprised that hæmoglobin and related pigments such as chlorocruorin have often been independently evolved, a suitable protein being combined with iron-porphyrin residue.

We know little as to the immediate source of CO_2. Two obvious processes are available, the dehydrogenation of formic acid, and the decarboxylation

of pyruvic acid and related compounds by the enzyme carboxylase according to the equation: $R-CO-COOH=R-COH+CO_2$. The enzymes concerned in both processes have a wide distribution.

Still less is known of how in detail the energy made available in oxidation is passed on, or of how the rate of oxidation is controlled, though both processes are evident enough in the whole organism. The control is largely exercised on the fuel supply. Thus a rise of blood sugar in man causes an increased oxygen consumption. Hormones such as thyroxin are also concerned, but their mode of action is not understood. The energy is not generally liberated directly, but is largely employed in building up compounds of high chemical potential. These may either form new tissue or be available for rapid energy production. Thus the oxidation of sugar or lactic acid in muscle provides energy for the resynthesis of glycogen from lactic acid, and of phosphagen from creatine and phosphate.

If these processes are to be efficient, two conditions must be fulfilled. The energy of oxidation must be made available in quanta somewhat, but not greatly, larger than those required for synthesis; and the molecules undergoing oxidation and synthesis must be united with the same catalyst, which must thus have a double specificity. The significance of the complicated oxidising systems here described will remain obscure until we know what syntheses are correlated with each of them. A beginning of such an analysis has been made by Wurmser.[14] But an indispensable preliminary is a study of the total and free energy changes in the various reactions which are linked. This is still in its very early stages.

But even when we know the stages in the oxidation of different substances, and the use to which the energy thus made available is put, we shall be faced with the problem of regulation. In the living cell the activity of peroxidase or lactic dehydrogenase is doubtless governed by laws as definite as those which govern that of the heart in the living organism, laws which can be stated both in terms of chemistry and of biological function. The question of whether these two types of explanation can be reconciled, or whether one of them is superfluous, will then have to be fought out. However, that day is far distant; meanwhile the biochemist can continue to accumulate knowledge without committing himself on philosophical questions.

[1] Warburg, "Über die katalytische Wirkungen der lebendigen Substanz", 1926.
[2] Wieland, *Ergeb. Physiol.*, **20**, p. 477; 1922.
[3] Dixon, *Biochem. Jour.*, **20**, p. 703; 1926.
[4] Coombs, *Biochem. Jour.*, **21**, p. 1259; 1927.
[5] Quastel and colleagues, *Biochem. Jour.*, 1924–1928 (Bibliography in *Jour. Hyg.*, **28**, p. 139; 1928).
[6] Cook, *Biochem. Jour.*, **24**, p. 1538; 1930.
[7] Bertho and Glück, *Naturwiss.*, **19**, p. 88; 1931.
[8] Zeile and Hellström, *Zeit. physiol. Chem.*, **192**, p. 171; 1930.
[9] Warburg and Negelein, *Biochem. Zeit.*, **202**, p. 202; 1928.
[10] Cook, Haldane, and Mapson, *Biochem. Jour.*, **25**, p. 534; 1931.
[11] Keilin, *Proc. Roy. Soc.*, B, **98**, p. 312; 1925: **104**, p. 236; 1929.
[12] Onslow and Robinson, *Biochem. Jour.*, **20**, p. 1138; 1926.
[13] St. György, *Biochem. Jour.*, **22**, p. 1387; 1928.
[14] Wurmser, "Oxidations et réductions", 1930.

Obituary.

Lieut.-Col. Sir Charles Bedford.

THE death of Lieut.-Col. Sir Charles Bedford, which occurred on July 8, terminates a career of scientific activity. Born in 1866, the youngest son of Dr. F. W. Bedford, headmaster of George Heriot's Hospital, Edinburgh, Bedford graduated in science and medicine at the Universty of Edinburgh and entered the Indian Medical Service in 1889. His special aptitude for work of an investigatory character was soon recognised in his appointment by the Punjab Government to be chemical examiner and professor of chemistry at Lahore Medical College. In 1897 he transferred to similar posts in Bengal. Whilst holding these appointments, Bedford rendered valuable assistance to the Indian Excise authorities, particularly in connexion with alcoholic liquors. He became scientific and technical adviser to a committee of investigation into excise questions, and later was appointed director of the Central Excise Laboratory, which was formed on the recommendation of that committee.

It was whilst holding these positions that Bedford performed his most valuable work. Under his direction an extensive investigation was made of all alcoholic liquors produced in or imported into India, their composition and physiological effects, with those of the by-products of manufacture. In 1907 he made a report upon the determination of alcoholic strengths. He submitted new tables intended for use with a glass Sikes's hydrometer in place of those which for upwards of a century had formed the basis of revenue charge. The old tables which were legalised in England in 1816 were compiled for use with a brass hydrometer and covered a range of temperature from 30° to 80° F. For use in warmer climates the tables were extrapolated to 100° F. Strengths determined under these conditions could be regarded as little better than approximations, and Bedford demonstrated that the inevitable errors operated for the most part against the revenue. The new tables were officially adopted in 1908, and remained in use until replaced in 1922 by others calculated from data which formed the basis of the British tables legalised in 1915.

Bedford was also responsible for the methods officially adopted in India for rendering unpotable, alcohol intended for commercial and industrial purposes.

After his retirement from the Indian Service, when he was rewarded with a knighthood, Bedford continued to render valuable service in various directions, being a member of numerous committees and occupying advisory positions at home and in connexion with the Dominions. Bedford also found time in the course of a busy life to indulge in considerable literary activity. One of his first publications was a memoir of his father, followed by a history of George Heriot's Hospital. His later

works included books on poisoning, enteric fever, and elementary hygiene in India. He received the honorary degree of LL.D. from St. Andrews and Edinburgh, and that of D.C.L. from the University of Oxford. R. R.

DR. R. C. MACFIE.

ON June 9, in a nursing home in London, Dr. Ronald Campbell Macfie passed quietly from amongst us with whom he had so quietly lived. He was not fond of the limelight, and was intimately known by few, by all of whom, however, he was greatly beloved.

An Aberdonian by birth, he was not in temperament true to type, for he was pre-eminently a man of feeling; yet it was also characteristic of him that he was never without some big problem to ponder over. He graduated in arts and in medicine in the University of Aberdeen, and continued his training in other schools at home and abroad. As locum-tenens at many places and consulting physician in health resorts, he saw a good deal of the world, and he had ever a keen appetite for beauty. With a very high ideal of health of body and health of mind, he lived an ascetic, highly strung life, often with a too strenuous struggle for existence, but, on the whole, rich in high joys and the delights of laborious days.

It was a great encouragement to Dr. Macfie when his poems brought him laureation from his Alma Mater, and he was almost pathetically pleased — two years ago — when he was asked to give the Thomson Lectures in the United Free Church College. These were published under the title "Science Re-discovers God", and they give noble expression to the main trend of his mind. He was spiritually minded, and was convinced that it is the business of science not merely to make the world intelligible, so that a religious interpretation may be more convincing, but to declare a theodicy. His scientific books dealt with heredity and evolution, with vitalism, with health, with the vital value of light, and most successfully of all, we think, with the romance of the body. They were characterised by sparkling lucidity, picturesque phrasing, poetic flashes, and an idealistic setting. His poems, which were his strongest self-expressions, are marked by their combination of music and high thinking. Many of them are little essays in philosophy, and yet at the same time they are melodies.

Of Ronald Campbell Macfie the world did not show itself quite worthy, but he did his day's work cheerfully.

MR. HENRY JAMES WADDINGTON, who died at Bournemouth on June 28 at ninety-one years of age, was well known to microscopic workers both at home and abroad. Many of his preparations, especially those of prawns and crabs, as well as various protozoa, are exhibited in the Natural History Museum, South Kensington. His wonderful manipulative skill at mounting the most delicate protozoa and insects in their natural condition was the admiration of all who came in contact with him. His knowledge of chemistry was an enormous help to him, and his successful preparation of realgar as a mounting medium of high refractive value, as well as his mounts of various diatoms in realgar, are known to many. Mr. Waddington was one of the founders of the Natural Science Society of Bournemouth, and was later presented with the gold medal of the society and elected honorary vice-president.

WE regret to announce the following deaths:

Dr. Francis R. Cross, who was reader in ophthalmology in the University of Bristol and formerly president of the Ophthalmological Society, on July 12, aged eighty-three years.

Prof. Harald Höffding, formerly professor of philosophy in the University of Copenhagen, known for his publications on philosophy and psychology, on July 2, aged eighty-eight years.

Sir Harry R. Reichel, emeritus rector of the University College of North Wales, Bangor, who was principal of the College for forty-three years and known for his work in education, on June 22, aged seventy-four years.

News and Views.

MR. HERBERT MORRISON, Minister of Transport, stated in the House of Commons, on July 24, that the Weir report on the electrification of the railways of Great Britain raises important issues of industrial policy and that the Government will consider its recommendations most carefully. In the opinion of some, an objection to the scheme is that, as the report indicates, the coal consumption will be reduced by 3·8 per cent, or nearly ten million tons a year. It is also true that part of the economy which will be gained will be secured by the reorganisation of the railway men. But it would be foolish to let these two facts prevent us from carrying out a great scheme of industrial improvement. In the making of our country industrially efficient it cannot be wrong to face the new problems and solve them in the same spirit that we solved similar problems in the past. It would be foolish to be frightened because the report deals with big figures. It is significant that the manager of the L.N.E.R. signed the report. The Government is at present discussing the report with the railway companies. The Weir Committee estimated that a return of about 7 per cent could be secured upon the new capital (£261,000,000) involved in electrification. In the present condition of affairs this remuneration would doubtless be welcomed by the companies, but it is doubtful whether they could at present attract the necessary capital without State assistance. At the recent N.U.R. Conference, Mr. C. T. Cramp, the General Secretary of the Union, welcomed electrification on behalf of the employees. He takes

it for granted that if the State assists to raise the capital it will assume some kind of control of the scheme. It is probable that a semi-public body of a central board type will have to be made. There is no reason why it should not prove to be as successful as the Central Electricity Board set up by the Electricity Act of 1926.

CONSIDERABLE advances have recently been made in controlling street traffic by means of visual signals. One of the largest of the synchronised systems has now been in operation for a few weeks in Oxford Street, London. It is the first system of this kind in Great Britain and its working will be watched with interest, as before it was started the traffic was very congested. A careful census of the main streets and the cross streets at all times of the day was first taken. From the data thus obtained the whole scheme was worked out. The signal lamps, green, amber, and red, are electrically connected with a ' controller ' fixed on one of the lighting poles and the length of the times the lights are on is easily controlled from it. The speed at which maximum street capacity and efficiency are obtained was roughly determined by the data obtained. It depends on road width, length of blocks, and the nature of the traffic. If the signals are set for a speed higher than the ideal speed, the traffic gets out of step with the system and there is a consequent slowing down. The Oxford Street system was originally set for a speed of thirteen miles per hour, but this has now been increased to a speed of fifteen miles per hour, and it is probable that still higher speeds will be used in the future. The relative density of the cross traffic is an important factor in the calculations. At important crossings such as the one at Oxford Circus, where the volume of the Regent Street traffic is practically the same as the Oxford Street traffic, equal periods of green are given in both directions. At less important crossings the main road has a longer green interval than the cross road. The master controller kiosk is situated on the north side of Oxford Circus and the whole system is controlled from it. There is a private telephone exchange in the kiosk which enables constables on duty to report instantly any defective signal. In the $1\frac{1}{3}$ miles of Oxford Street there are twenty-one groups of traffic signals.

SINCE the War, a very peculiar form of degeneracy has been observable in London sparrows—the breakage of the tail-feathers some time after the moult; this generally occurs close up to their roots, so that at first sight the bird looks as if it had had the quills pulled out, but on close inspection stumps are to be seen, and in some cases the breakage is in the middle of the tail. In any case, it is the outermost feathers that break off nearest the roots, the point of breakage becoming more distant until the central pair are reached, so that the broken tail presents a rounded outline, whereas the undamaged tail is slightly forked. Birds thus affected may be seen in widely separated London districts, and it is curious that they are not otherwise degenerate; their general plumage and condition are average and may even be exceptionally good, while they are often to be seen in company with an intact mate or collecting food for young. Moreover, whatever causes the breakage of the tail-feathers operates quickly on all, as it is rare to see a bird with the tail containing both intact and broken feathers. Before the War, birds showing white feathers here and there were common; then these disappeared for some years, and have only been noticeable again for the last year or two, when, like the broken-tailed birds, they appeared at widely separated points in London: so that whatever cause produces these defects—which are common to both sexes—it operates independently on many isolated individuals.

ALL the four forms of jungle-fowl (*Gallus*) are now to be seen at the London Zoological Gardens—a most instructive exhibit, as the genus is so natural that all recognise the birds immediately as fowls; and yet the species are so distinct that even the hens are as different in plumage as are our four common spotted thrushes—missel, song, redwing, and fieldfare. The cocks are strikingly unlike, as much in voice as in plumage and in details of feathering and head appendages. The most aberrant is the Javan *G. varius*, which has no neck-hackle or wattles, and has indeed been separated as *Creagrus*; yet it agrees with the common *G. gallus* in having the underparts black in the male and brown in the female, and with the Ceylonese *G. lafayetti* in the bold black barring of the wings in the latter sex, in the possession of a dewlap by the male—though this in *lafayetti* is very small—and in the eyes being yellow in both sexes. Between it and the south Indian *G. sonnerati* no special resemblance can be traced; but this agrees with *G. gallus* in having orange-red eyes and in the males assuming ' undress ' neck-feathering after breeding, and with *G. lafayetti* in having the underparts hackled and striated in the male and variegated with black and white in the female, while in these two alone the legs are red in the former and yellow in the latter sex. Yet the male of *G. lafayetti* agrees with that of *G. gallus* in showing much red in the plumage, and in flapping the wings before crowing, unlike the two others; while it may be noted finally that in none of the species except the last-mentioned is the crow at all like that of any tame fowls.

A STATISTICAL report on the third year's operations of the Bureau for Contraceptive Advice, Baltimore, by Prof. Raymond Pearl, is contained in the third report of the Bureau (Baltimore, Maryland, 1931). It is considered that the Bureau has been in operation too short a time to warrant any report on either the relative or the absolute effectiveness of the advice given as to the technique of contraception. In a group of 183 women who came for advice, the average number of pregnancies was 5·5 and the average number of children was 4·7. But their average age was only thirty-one years, and the average duration of marriage was eleven years. These are high reproductive rates which cannot be regarded as helpful to either private or public health. All the women who came to the Bureau were married, and the experience of the Bureau so far demonstrates that there is no validity in the argument sometimes advanced against

the giving of contraceptive advice, to the effect that it is chiefly sought by the young as a means of escaping the moral responsibilities of marriage. In this connexion, it may be mentioned that the Ministry of Health has issued a *Memorandum* (153/M.C.W.) stating that local authorities in Great Britain have no general power to establish birth control clinics as such, but that they have under the Public Health Acts power to provide clinics at which medical advice and treatment would be available for women suffering from gynæcological conditions, and that in these advice may be given on contraceptive methods, restricted to married women who attend and in whose cases pregnancy would be detrimental to health.

NEW seismological stations have recently started work in China, Denmark, and Scoresby Sound, Greenland. When the disastrous Kansu earthquake occurred on Dec. 16, 1920, the only seismological station in the whole of China was that of Zikawei, near Shanghai, under the charge of Father Gherzi. Soon after the earthquake, Mr. Wong Wen-hao, the Director of the Geological Survey of China, suggested to the Government that a station should be established in North China, but it was not until September 1929 that permission was given. The place chosen is Chiufeng, about twenty-two miles north-west of Peking (lat. 40° 3′ 55″ N., long. 116° 5′ 46″ E.). The building in which the first instruments (Wiechert horizontal and vertical seismographs) are installed is situated on a granitic hill, 508 feet above the sea. It has been placed under the charge of Mr. S. P. Lee, who has recently issued the first two numbers of the *Seismological Bulletin*, containing the records for about the last three months of 1930. Though they have been somewhat longer at work, a description of the two stations belonging to the Danish Geodetic Institute has recently been published. The station near Copenhagen (opened in November 1926) consists of two caponnieres of the old fortifications, 3¾ miles from the outskirts of the city, both well protected from damp, changes of temperature, and artificial vibrations and provided with Galitzin, Wiechert, Milne-Shaw, and Wood-Anderson seismographs. The second station, containing a set of Galitzin pendulums, is erected at Scoresby Sound, on the east coast of Greenland (lat. 70° 29′ N., long. 21° 57′ W.), and has been at work since January 1928.

IN a recent weekly circular issued by the Ministry of Agriculture, attention is directed to the scheme of exchange of British and Danish agriculturists inaugurated in 1924, under which Danish students are enabled to live and work on farms in Great Britain in order to study English farming practice, and an equal number of young British agriculturists are afforded equivalent opportunities in Denmark. The students are required to pay their own travelling expenses and to undertake regular farm work for a period of from three to twelve months, in return for which free board and lodging is provided but no money paid. Up to the present, only a few students from England have visited Denmark, although the young Danish farmers have made a much fuller use of the exchange scheme. It is, therefore, hoped that more British students will avail themselves of the advantage of this unique opportunity of gaining, at very low cost, an insight into the farming practice of one of the leading agricultural countries. Dairy farming in general, the scientific economic feeding and breeding of dairy cattle, co-operative production, marketing, etc., are the chief branches that may be studied. Those intending to proceed to Denmark for a period of six months or less should arrange to start either early in November or early in May. Agricultural students in England and Wales wishing to take advantage of the scheme should make application through the principal of their college or farm institute (if they have attended such an institution), or through the agricultural officer of the county in which they are resident.

MR. JAMES J. JOICEY, in continuation of a policy pursued by him for many years to the great benefit of the British Museum (Natural History), has presented to the Department of Entomology a further selection consisting of 800 butterflies of very great value and interest from the point of view of the systematic student. These are nearly all 'type' specimens, some of which are unique, that have formed the basis of original scientific work published by Mr. Joicey himself or by other well-known entomologists whose collections have passed into his hands. Two nearly complete skeletons of the reptile *Pachypleurosaurus* from the Alpine Trias have been acquired by the Department of Geology. These animals were shaped like lizards, less than a foot long, and probably lived partly in and partly out of the water. Acquisitions for the Department of Minerals include a small fragment sawn from the 12-ton mass of meteoric iron found in October 1930 near Mbosi, between Lakes Nyasa and Tanganyika, in Tanganyika Territory, presented by Mr. H. V. B. Lloyd Phillips. A fragment of a meteoric stone has been detected amongst the rocks and minerals collected by Mr. Bertram Thomas during his recent expedition across Central Arabia. The Department of Botany has purchased the collections which formed the basis of Dr. Albert Pilát's monographs on Stereaceæ and Aleurodiscaceæ containing 727 specimens of fungi.

THE Imperial Sugar Cane Research Conference, held by the Empire Marketing Board, which concluded on July 24, has recommended the establishment of a chain of four central cane-breeding stations to assist the Empire's sugar industry. Barbados was selected as the site for a cane breeding station in the West Indies. It was recommended that one-third of the expense should be met from Imperial funds and two-thirds by Barbados itself. The three other cane breeding centres would be located in India, Mauritius, and Australia. It was also recommended that a quarantine station should be set up in the West Indies, through which all canes being imported or moved about should pass. Fungus diseases often cannot be detected at once by the most experienced expert, and sometimes they lie dormant in the cane for over a year.

Research on the improvement of agricultural methods, the better interchange of information, and the exchange of workers, are aspects of scientific work which the Conference desires to see extended. It recommended that work on the biological control of insect pests should be continued in the West Indies, and provision should be made for its extension to other Empire countries as occasion may demand.

In a pamphlet entitled "Mass Production" (Pelican Press, London, 6*d*.) Sir Eric Geddes argues that a protected home market is essential to enable British manufacturers to compete with foreign mass production. He points out that since the War the methods of mass production have developed with great rapidity and its power for the well-being of mankind is enormous, since by cheapening prices it has brought articles of convenience and luxury into the homes of millions who last century could never have dreamed of being able to afford such things. In illustrating the advantages of mass production, Sir Eric Geddes utilises some very interesting diagrams. One of these refers to the drilling of holes in a metal plate, which if done accurately by hand would require a high degree of skill. If performed by a machine, the work no longer depends on the skill of the operative but on the accuracy of his tool, and the cost is seventy-seven times less than that of hand production. In another diagram it is shown that the proportion of labour cost may fall from 50 per cent to 25 per cent when mass production methods are used. To-day the cost of research, experiment, planning, equipment, power, and the maintenance and depreciation of machinery overshadows the cost of productive labour in importance. In the British motor industry, through the partial adoption of mass production methods, workers' earnings have been about doubled since 1914 although prices to the consumer have fallen about one-half.

It is announced in the *Scotsman* of July 25 that St. Kilda, having been in the hands of the Macleods of Macleod for centuries, has changed owners. Naturalists in general, and ornithologists in particular, will rejoice that its new ownership ensures that the fauna and flora will remain undisturbed, and that the island may be recognised as a natural sanctuary for beasts and birds. Here, if anywhere, the study of the effects of isolation upon species is likely to yield good results. The new owner is the Earl of Dumfries, the eldest son of the Marquess of Bute. Lord Dumfries, born in 1907, is a keen ornithologist who has a first hand knowledge of the birds of southern Europe as well as of Great Britain, and has taken an interest in the arranging of the bird collections in the museum at Rothesay. We understand that all the amenities of St. Kilda will be carefully preserved and safeguarded by the new proprietor, who does not intend to put the island to any commercial use whatsoever.

The census of Indian mosses (with analytical keys to the genera) published by P. Brühl in the *Records of the Botanical Survey of India*, vol. 13, No. 1, is a large undertaking on which he should be congratulated. The census is at present far-reaching, including Malay to the east and the Caucasus and intervening countries to the west, but as the mosses of these various regions show affinities with those of the various regions of India the wider nature of the census is justified. The addition of keys to the genera and the great advantage gained by the identifications being made possible on vegetative characters will add greatly to the value of the work. Even in Great Britain, it is of enormous advantage to be able to name a moss in the absence of sporogonia, and this must apply much more to bryology in India. Such a census, combined with the keys, should be a big step towards attracting workers in India to bryology; and if students are able to identify a specimen at least so far as to place it in a genus, this should enable them to contribute much to the more detailed knowledge of the mosses and their distribution and, at the same time, to do so without adding unnecessarily to the work of the experts on whom the ultimate identification is almost bound to devolve at the present time.

Geneva is now the centre not only of the Société des Nations and of the Bureau international de Travail, but also of numerous other societies which have already grouped themselves together in the Fédération des Institutions internationales (semi-officielles et privées) établies à Genève; secretary, Bertram Pickard, 5 Place de la Taconnerie. A list of these will be found in the "Annuaire international de Genève", published by the Centre permanent d'informations internationales, Place des Bergues, 3, Genève. Reference to the League of Nations "Handbook of International Organisations", 1929 edition, shows in the index pages how organisations are developing at other world centres: for example, 14 societies in Vienna, 54 in Brussels, 101 in Paris, 51 in London. Those in Brussels have a possible rallying point in the Palais Mondial, Parc du Cinquantenaire; in Paris the Institut International de Coopération Intellectuelle (2 rue de Montpensier, Palais Royal, Paris, 1er) already organises ententes and liaisons, and its news is published monthly in a *Bulletin de la Coopération Intellectuelle*.

The late Dr. Bashford Dean, organiser and curator of the Department of Fishes, Recent and Fossil, in the American Museum of Natural History, New York, was remarkably skilled in making drawings of zoological and anatomical preparations. He left many valuable original drawings to illustrate the embryology of three of the lowest existing fishes, and some of his former colleagues and students have now decided to publish these drawings, with explanatory text based so far as is possible on Dean's own notes. The whole will form one quarto volume, entitled "The Bashford Dean Memorial Volume—Archaic Fishes", and will be edited by Dr. Eugene W. Gudger. A preliminary part of the volume, which has already appeared, contains an admirable memorial sketch of Dr. Dean by Prof. William K. Gregory, accompanied by a photogravure portrait, five other portraits which were taken at different periods of his life and activity, and photographs of the tablets to his memory which have been placed in the American Museum of Natural History

and the Metropolitan Museum of Art, New York. There is also a complete list of Dr. Dean's writings, including both those on biological subjects and those on armour.

THE Engineering Societies Library of America announces the completion of arrangements for the publication of a series of technical treatises to be known as "Engineering Societies Monographs". The editorial supervision of this series will be in the hands of a committee consisting of Harrison W. Craver, director of the Engineering Societies Library, chairman, and two representatives appointed by each of the following engineering societies: American Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers. The aim will be to publish important technical manuscripts which have proved too extensive for publication in the periodicals or proceedings of engineering societies or in other journals, and of too specialised a character to justify ordinary commercial publication in book form. The Engineering Societies Library will share in any profits made from publishing the monographs; but the main interest of the societies is service to their members and the public. The monographs will not be a series, in the common use of that term. Physically they will have similarity, but there will be no regular interval in publication or uniformity in price, or relation in subjects. The first volume projected for the series is "Plasticity", by Dr. A. Nadai. It is an adapted and revised translation of Dr. Nadai's well-known treatise in German on this subject.

WE have received from P. J. Kipp and Zonen, of Delft, Holland, a leaflet describing an interesting type of ammeter for measuring very minute alternating currents. It consists of four vacuum thermocouples arranged like the arms of a Wheatstone bridge. A sensitive galvanometer is arranged across one of the diagonals and the terminals are at the extremities of the other: when no current flows, the thermocouples are in equilibrium, the total resistance being twenty-five ohms. An A.C. of one milliampere generates a P.D. of 22·5 microvolts across the terminals of the galvanometer. With a Moll galvanometer, we get a deflection of 500 mm. at a distance of one metre. The four thermocouples are protected against outside disturbances by double-walled metal covers. The instrument can be loaded up to a hundred milliamperes, and can be calibrated with direct current. The Moll galvanometer has a resistance of 50 ohms and a sensitivity of 6×10^{-9} amp. per mm. when the scale is one metre away. The *Zc* galvanometer has a resistance of fifteen ohms and a sensitivity of 10^{-10} amperes.

THE liver treatment of pernicious anæmia is now well established: there are very few cases which do not respond to the administration of fresh liver or a potent extract, and very few which relapse when the treatment is continued regularly. Liver, in fact, has completely changed the outlook for the patient suffering with pernicious anæmia. More recently it has been found that stomach, especially that of the pig, is as effective as liver, and that dried stomach is as potent as fresh. Achlorhydria is an invariable sign in pernicious anæmia. This suggested to Castle that the disease might be due to the failure of the stomach to secrete some principle which formed the anti-anæmic substance from the food, or which was itself a potent source of this substance. Reports from numerous observers indicate that desiccated stomach is as effective as, or even better than, liver in the treatment of pernicious anæmia. The British Drug Houses, Ltd., now issue a potent preparation under the name Gaster Siccata B.D.H. The curative dose is about 30 gm. daily and the maintenance dose 10 gm. The material is almost fat free, odourless and tasteless, and forms a smooth, palatable mixture when suspended in milk.

A LARGE meeting of biologists, including leading representatives of genetics, medicine, and anthropology, was held at the London School of Economics on July 21, to consider the question of the present state of research in human genetics and to explore the possibilities of its immediate development. The lack of facilities for research in a subject so vital to the human race as human genetics was generally deplored, and it was decided to seek ways and means to establish in London a central body of experts, who would organise, develop, and foster sound research in human genetics within the Empire by means of grants obtained from various sources. The following Committee, with power to add to its number, was appointed to take immediate action: Sir Daniel Hall (*chairman*), Sir William Beveridge, Prof. F. A. E. Crew, Sir Walter Morley Fletcher, Prof. R. Ruggles Gates, Prof. J. B. S. Haldane, Prof. Lancelot Hogben, Sir Bernard Mallet, Dr. Redcliffe Salaman, Prof. C. G. Seligman, and Dr. C. C. Hurst (*secretary*).

FOR several years Mr. W. R. Dunlop, of 2 Lynton Road, Hythe, Kent, has been engaged in an objective study of individual mental activity amongst men of business. The field is a new and difficult one and nothing has yet been published. Mr. Dunlop asks for the co-operation of other scientific workers in order that he may investigate the possibilities of a comparative inquiry. He wishes to obtain information which will enable him to compare the working of the mathematical mind with that of the business mind. He wants, especially, information as to how mathematical concepts arise, particularly the extent to which they are definitely suggested by environmental experiences. The opportunity of making a brief systematic analysis of the working of the mathematical mind generally is desired, and Mr. Dunlop asks whether any readers of NATURE would be interested and kind enough to put him in touch with one or more originally-minded mathematicians who would be prepared to co-operate as subjects in a very brief preliminary inquiry.

A SPECIAL exhibition of primitive rafts and canoes, which has been designed to show the successive developments by which these primitive craft have given rise to the built boats of modern Europe, is on view in the entrance hall of the Science Museum, South Kensington, and will remain there until September. These will be illustrated by means of about forty models, and also by sixty illuminated

photo-transparencies showing native canoes in actual use. Of special interest is a comparison between the method used by the ancient Egyptians in boat-building and that which is still employed in the almost exactly similar boats of the Ganges; a suggestion is also made of the origin of the Chinese sampan as a development from the catamaran of the Madras coast. Among other primitive types are models illustrating the ways in which the ancient Babylonians, like their modern descendants, used oxhide as a means of transport on the Tigris. A contemporary model of the double-hulled boat built by Sir William Petty in 1663, which has been lent by the Royal Society, provides a very interesting comparison with other double-boats from many parts of the world.

PROF. ENGLEDOW, the chairman of the National Institute of Agricultural Botany, who presided at the annual general meeting of fellows at the Institute's headquarters, Cambridge, on July 24, addressed the audience on the policy of the Institute, and laid particular emphasis on the value of co-operation between national and county organisations and the progress already made in this direction. The Institute with its own seven trial stations has gone far in sifting existing material and stimulating plant breeding, and it is already dealing with thirteen crops and hundreds of varieties. Co-ordinated trials are in progress at 107 centres in 46 counties. This unique undertaking, on a national scale, will provide information of first-rate importance and at the same time ensure that the results are brought home to the farmer. Co-operation of this sort is of inestimable benefit to agriculture; it cannot be too widely known that the Institute's accumulated experience and resources are ever at the service of all who need them, and in particular of county organisers.

THE president of the Board of Education has appointed Sir Richard Glazebrook to be chairman of the Advisory Council of the Science Museum in succession to the late Sir Hugh Bell, Bart.

SIR HUBERT WILKINS, who is contemplating a journey under the ice-cap to the north pole by means of his submarine *Nautilus*, was presented with the gold medal and diploma of the Italian Royal Geographical Society on July 23 on board the *Nautilus*, in recognition of his services to science in connexion with polar research work.

THE Development Commissioners have appointed Prof. G. C. Bourne, Linacre professor of zoology and comparative anatomy in the University of Oxford, to be chairman of their Advisory Committee on Fishery Research in succession to Sir William Hardy, who has resigned. Sir William will remain a member of the Committee, of which he has been chairman for twelve years.

BY an order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, the Right Hon. Lord Dawson of Penn, president of the Royal College of Physicians and physician to the London Hospital, and Prof. Edward Mellanby, professor of pharmacology in the University of Sheffield, have been appointed members of the Medical Research Council in succession to Prof. T. R. Elliott, and Prof. J. B. Leathes, who retire in rotation on Sept. 30.

THE Minister of Health received on July 15 a deputation of members of parliament on the question of the abolition of compulsory vaccination. Mr. Leach said that their object was to secure that compulsory vaccination should be abolished, and they hoped that the Government would introduce, or give facilities for, the necessary legislation. The Minister pointed out that the administration of the Vaccination Acts is now in the hands of the larger local authorities, and the Government would await the experience of the operation of the Acts before contemplating any drastic amendment of the law, to secure which, complicated and highly controversial legislation would be necessary.

A CATALOGUE (No. 17) of some 800 second-hand works on natural history, botany, and horticulture has recently been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chief dairy instructor at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Essex County Council, Shire Hall, Chelmsford (Aug. 10). A lecturer in mechanical engineering at the Birmingham Central Technical College—The Principal, Central Technical College, Birmingham (Aug. 10). An assistant in agricultural zoology under the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, Stormont, Belfast (Aug. 14). A senior demonstrator in anatomy at St. Thomas's Hospital Medical School—The Dean, St. Thomas's Hospital Medical School, S.E.1 (Aug. 15). An assistant lecturer in mechanical engineering at the Hull Municipal Technical College—The Director of Education, Education Offices, Guildhall, Hull (Aug. 15). A physiological chemist at the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (Aug. 22). A demonstrator in zoology in the University of Leeds—The Registrar, University, Leeds (Aug. 24). A research metallurgical analyst under the British Non-Ferrous Metals Research Association—The Director, British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, N.W.1 (Aug. 24). A junior assistant in civil engineering at the Queen's University of Belfast—Prof. Hummel, Queen's University, Belfast (Sept. 1). A university reader in pathology at Westminster Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Sept. 18). A Wandsworth scholar at the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (Sept. 29). An Oxford or Cambridge graduate in physics to teach physics at Clifton College—The Headmaster, Clifton College, Bristol. An assistant pathologist at the Royal Northern Hospital, Holloway—The Secretary, Royal Northern Hospital, Holloway, N.7.

ERRATUM.—In the obituary notice of Major T. F. Chipp in NATURE of July 25, p. 142, par. 2, line 1, for "1919" read "1929".

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor 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 Method of Recording Coincidences between Geiger Counters.

RECENTLY the recording of coincidences between Geiger counters has become of considerable interest, and several experimental arrangements have been described for this purpose.[1] A common property of these arrangements is that the resolving power is of nearly the same magnitude as the duration of an impulse from the counter (about 2×10^{-3} sec.). Impulses occurring within a time interval shorter than

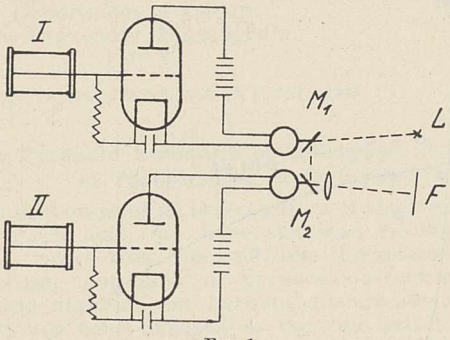


FIG. 1.

this are recorded as true coincidences. The method to be described here gives a resolving power about ten times higher; at the same time, it suffers from the disadvantage that the coincidences must be recorded photographically and not by mechanical summation, as is the case with the arrangements mentioned above.

Two Geiger counters *I* and *II* (Fig. 1) are connected to the grid of amplifying valves with grid leaks of 5×10^8 to 5×10^9 ohms. The anode current of the valves is sent through moving iron oscillographs of a type similar to that described by Wynn-Williams and Ward.[2] Light from an arc lamp *L* is reflected successively from the plane mirrors M_1 and M_2 of the oscillographs and concentrated by a lens on a slowly moving film *F*. The deflections of M_1 and M_2 are crossed, so that one mirror gives a horizontal deflection, the other a vertical one.

In Fig. 2, *x* represents the direction of the movement of the light spot on the film, and *I* and *II* indicate deflections given by the two mirrors independently. With a natural frequency of 1000 of the oscillograph, the time taken by the light spot to reach full deflection is nearly equal to the duration of the impulse from the counter; the movement of the light spot back to zero deflection is determined by the discharge of the grid capacity over the grid leak, and can be varied at will within certain limits. If a coincidence occurs, the two mirrors commence their movements simultaneously, and the deflection obtained on the film makes an angle of 45° with the direction of *x* (Fig. 2, *a*). If the impulses from the counters occur with a time difference, the deflection appears as a broken line, as

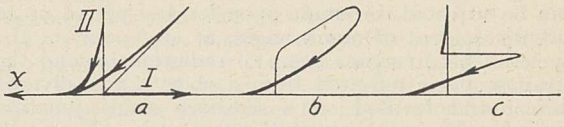


FIG. 2.

indicated in Fig. 2, *b* and *c*, where the time difference is shorter or longer respectively than the duration of the impulse. The position of the kink gives an estimate of the time difference between the impulses. On actual photographs, the smallest time difference which can be detected with certainty is about a tenth of the time taken to reach a full deflection, or about 2×10^{-4} sec. This quantity represents the resolving power of the arrangement. The same value for the resolving power was obtained by counting the number of coincidences when the counters were excited by γ-rays, the coincidences being regarded as accidental. When the same particle (α- or β-particles) was sent through both counters, all coincidences were true (apart from natural effect), so that the time lag in the action of the counter, if it exists, must be identical for the counters used to within 2×10^{-4} sec.

J. C. JACOBSEN.

Institut for teoretisk Fysik,
Copenhagen, June 20.

[1] W. Bothe, *Zeit. f. Phys.*, **59**, 1; 1930. Bruno Rossi, NATURE, **125**, 636; 1930. Hummel, *Naturwiss.*, **18**, 567; 1931.
[2] *Proc. Roy. Soc.*, **131**, 391; 1931.

An Investigation of Infra-Red Radiation from an Engine.

A PRELIMINARY investigation of infra-red radiation from a small single cylinder Otto cycle engine delivering power has just been completed.

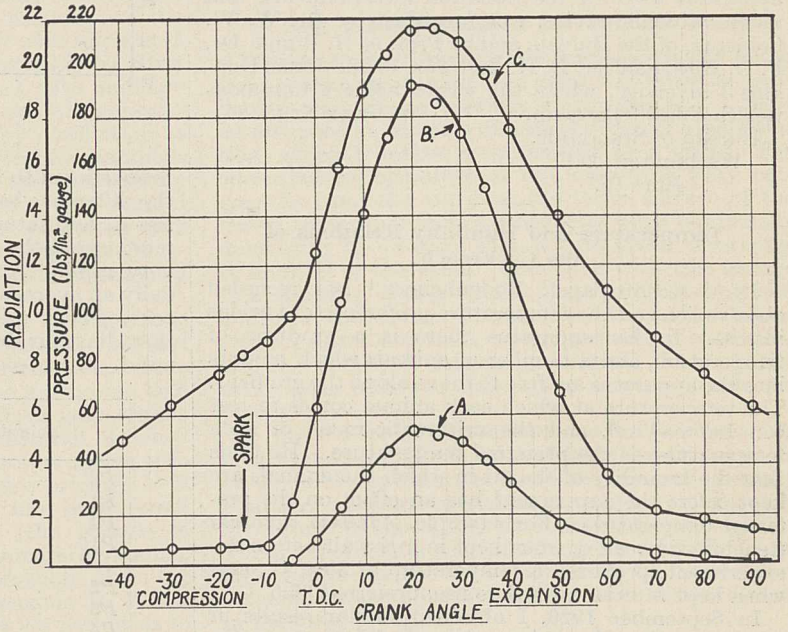


FIG. 1.

The radiation passes through a fluorite window, slightly greater than three millimetres in diameter, and three millimetres thick. Thirty-one positions sym-

metrically distributed over the combustion chamber are available for the window, and in each a view is obtained through a small depth of charge, in a direction perpendicular to the motion of the flame. By a system of surface silvered mirrors the radiation is brought to a focus on the slit of a stroboscope, which can be adjusted to remain open for any period up to twenty degrees of crank angle, at any point of the cycle. The divergent beam of radiation beyond the stroboscope is reflected from a short focus silvered mirror and focused on a sensitive single junction antimony-bismuth vacuum thermocouple. The e.m.f. generated is measured on a Moll galvanometer with scale at two metres, mounted near the engine on large concrete blocks insulated by heavy rubber, which absorb the engine vibrations at all operating speeds.

The curves submitted (Fig. 1) are plotted on a crank angle base, and show: (*A*) Radiation to 4·4 μ; (*B*) radiation to 10 μ; (*C*) pressure in the combustion space. Curve (*A*) was obtained by placing a piece of plate-glass 4·5 millimetres thick in the path of the rays. The engine was operating without detonation on a commercial petrol (sp.gr. 0·733) at 900 r.p.m., and the radiation was measured through a window two centimetres from the sparking plug, with the stroboscope open for eight degrees.

By using a more sensitive galvanometer the stroboscope opening may be reduced to one degree, with an increase in the significance of the readings. Liquid and gaseous fuels can be used in the engine, and filters will permit measurements to be made over predetermined wave bands. Information on combustion, depth of the reaction zone behind the flame front, and detonation will be sought.

The study of infra-red radiation from an engine, conceived as a promising piece of graduate research, was fortunately considered complementary to an investigation (for the National Advisory Committee for Aeronautics) of combustion in an engine cylinder, proceeding at the Automotive Power Plants Section of the Bureau of Standards; permission to co-operate was very kindly granted by Dr. H. C. Dickinson. The apparatus used for the radiation measurements, and much valuable advice, was furnished by Dr. W. W. Coblentz, of the Bureau, and by Prof. A. H. Pfund, Dr. F. O. Rice, and Dr. D. H. Andrews, of the Johns Hopkins University, where the writer holds a Commonwealth Fund fellowship.

SYDNEY STEELE.

Bureau of Standards,
Washington, D.C.,
June 15.

Temperature and Humidity Relations of the Cockroach.

IN a recent paper, Bodenheimer [1] has recorded observations on the temperature-preference of various insects. In his apparatus there is a gradient of temperature, and a number of animals which he puts into the apparatus are free to move along the gradient. The temperature at which each animal comes to rest can be read off, and the arithmetic mean of such temperatures is the preferred temperature. He finds that the humidity of the air in which the animals are kept *before* the experiment has an effect on the preferred temperature. For example, *Adesmia clathrata* (tenebrionid beetle), when kept in moist air before the experiment, preferred a temperature of 39·4° C., and when kept in drier air before use, preferred 36·6° C.

In September 1929, I obtained similar results in the course of work on the cockroach, *Blatta orientalis*. The animals were kept in an apparatus similar to the above for four days. In one experiment the air was dry, and in the other it was moist (15·4 mm. v.p., saturated at 18° C.) though not saturated at any but the lowest temperature. At intervals during the four days the temperature-preference was found: the animals were stirred up and then given 20–30 minutes to come to rest before the temperatures were read. The accompanying diagram (Fig. 1) shows how, as time goes on, the insects settle at progressively lower temperatures; each point on the graph represents the average of at least sixteen temperature readings. The change in temperature-preference is much more rapid in dry air than in moist. (I think that the flattening of the dry air curve at about 20° C. is due to the fact that much lower temperatures were not available to the animals, and that the fall in preferred temperature would have continued below 20° C. had the cold end of the gradient been colder. Certainly I have since then had animals which preferred lower temperatures.)

It is well known that insects lose water by evaporation. My experiments show that adult male *B. orientalis* lose water at a rate that is, very roughly,

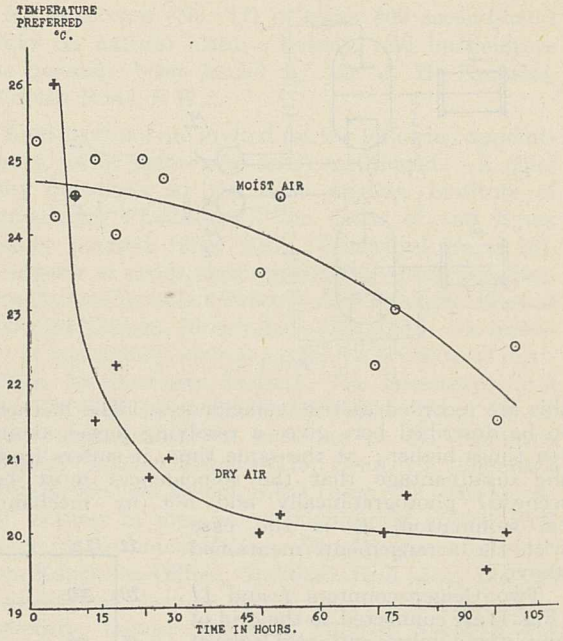


FIG. 1.

proportional to the drying power of the air, that is, to the difference between the vapour pressure of water in the air and saturation pressure (both in millimetres of mercury) at the same temperature. Such loss may be very rapid. At 30° C. in dry air these animals lose daily an average amount of water equal to about 9 per cent of their original weight, and this continues until they die (four days). With these two observations in mind, I proceeded to investigate the temperature-

Animal.	Percentage of dry weight.	Temperature preferred.
*P*3 . . .	25·2	25½
*P*1 . . .	28·0	24½
*P*4 . . .	28·7	25½
*P*10 . . .	29·6	25
*P*2 . . .	30·8	19½
*P*6 . . .	30·9	18
*P*5 . . .	31·3	20½

preference of individual animals, and then—by drying them to constant weight at 100° C.—to find the proportion of water they contained. The investigation is

still in progress and complete results for *B. orientalis* are not yet available, but a few observations which I have made on *Periplaneta americana* show a correlation between dry weight percentage and temperature-preference.

It appears that when the percentage of water has fallen below a certain minimum, the animal seeks a lower temperature than it did previously. Thus, when the animal is kept in air which is not saturated, it loses water at a rate which depends on the drying power of the air. Its percentage of water falls and it then has a lower preferred temperature, with the result that, whether the air is dry or not, it finds itself in air of lower drying power than previously and further loss of water is reduced.

Further work has shown that the food which *Blatta* is given also affects its temperature-preference, and in particular a diet of nothing but sugar solution has a marked effect. A full description of my experiments will be published shortly. D. L. GUNN.

Department of Zoology,
The University, Birmingham,
July 2.

[1] *Zeit. für vergl. Physiol.*, vol. 13, p. 740; 1931.

The Pyranoid Structure of Glucuronic Acid and of Theophylline Arabinoside.

IN the course of an investigation of the structure of glucuronic acid, we have obtained results which clearly prove that this acid, like the related hexose *d*-glucose, possesses a pyranoid structure. Our starting material was bornyl-*d*-glucuronide (borneol glucuronic acid) isolated as the zinc salt from the urine of humans and dogs receiving small doses of borneol.

Bornyl-*d*-glucuronide has been methylated and the resulting methyl ester of trimethyl bornyl-*d*-glucuronide, which was obtained crystalline, has been converted to the methyl ester of trimethyl methyl-*d*-glucuronide by the use of 1 per cent sulphuric acid in methyl alcohol at 100°. The fully methylated glucuronide, obtained as a liquid mixture of the α- and β-isomerides, has been oxidised with nitric acid ($d = 1{\cdot}42$), using the method first described by Hirst and Purves.[1] The product consisted of a mixture of *d*-dimethoxysuccinic acid and *i-xylo*-trimethoxyglutaric acid. These were purified by distillation as the esters and identified as the crystalline diamides. The final result is therefore similar to that obtained by Hirst [2] in his study of the structure of the normal derivatives of glucose, and a similar conclusion may be drawn in the present case, namely, that the glucuronic acid residue in bornyl glucuronide possesses a ring structure of the pyranoid type.

Challinor, Haworth, and Hirst,[3] from a comparison of the rates of hydrolysis of trimethyl-β-methyl glucuronide and β-methyl glucopyranoside, have deduced a pyranoid structure for the glucuronic acid component of the aldobionic acid from gum arabic. Our direct chemical evidence from material obtained by synthesis in the living animal therefore agrees with that derived from a product of plant origin. In a further series of investigations it has been found possible to methylate *d*-glucurone (the lactone of glucuronic acid) to yield two stereoisomeric crystalline trimethyl glucurones. It seems probable that the second ring system in these compounds is of the furanoid type, but our results do not yet permit us to state that this is so.

Investigations in progress in this laboratory concerning the nature of the sugar of nucleic acids necessitated the synthesis of a purine pentoside. Theophylline arabinoside was selected on account of the stability of its purine residue, and having the material at our disposal the structure of the pentose residue was investigated by the standard methods. The synthesis of theophylline-*l*-arabinoside has been described by Helferich and Kühlewein,[4] and their procedure, using silver theophylline and triacetyl arabinosidyl bromide, has been followed with excellent results.

In view of the method of synthesis adopted, the question of structure possesses a further interest in that a proof of the structure of the pentose residue in the arabinoside establishes by implication the structure of the triacetyl arabinosidyl bromide used in the initial step of the synthesis. No difficulty was experienced in methylating completely the arabinoside and the trimethyl theophylline *l*-arabinoside obtained crystallised readily. The latter was subjected to the action of nitric acid ($d = 1{\cdot}2$) and the main oxidation product of the pentose residue proved to be *d-arabo*-trimethoxyglutaric acid, which was isolated in excellent yield as the dimethyl ester and identified as the crystalline diamide described by Hirst and Robertson.[5] We therefore infer that theophylline arabinoside and triacetyl arabinosidyl bromide are pyranoid compounds. The purine residue of the original arabinoside was isolated as a yellow crystalline compound (m.p. 275°) which reacted and analysed as a nitro-theophylline having the composition $(C_7H_7N_4O_2.NO_2)_2.H_2O$. Brunner and Leins [6] have described a nitro-theobromine, but we have been unable to find any reference in the literature to nitro-theophylline. Our compound is presumably 8-nitro-theophylline.

JOHN PRYDE.
R. TECWYN WILLIAMS.

Physiology Institute,
Newport Road, Cardiff,
July 3.

[1] *Jour. Chem. Soc.*, **123**, 1356; 1923.
[2] *Jour. Chem. Soc.*, 350; 1926.
[3] *Jour. Chem. Soc.*, 258; 1931.
[4] *Ber. der Deutsch. chem. Gesell.*, **53**, 17; 1920.
[5] *Jour. Chem. Soc.*, **127**, 358; 1925.
[6] *Ber. der Deutsch. chem. Gesell.*, **30**, 2584; 1897.

A New Virus Disease of the Tobacco Plant.

IN recent years investigators have recognised many virus diseases of the tobacco plant, all, however, producing chlorosis or necrosis of the leaves. I have investigated at Amani a disease of different manifestation, which I believe to be caused by a virus. The characteristic symptom of this disease is leafy outgrowths from the veins on the lower surface of the leaves, sometimes up to a centimetre wide, but usually amounting to no more than a dark green thickening of sections of the veins. Combined with this feature is a stunting of the whole plant and twisting and curling of the leaves. The manifestation of the disease varies greatly according to environmental conditions and the variety of tobacco concerned. I have, however, never observed chlorosis or necrosis in affected plants.

I have successfully transmitted this disease to healthy tobacco plants by grafting diseased scions on to them. I have also produced the disease in healthy plants by transferring to them an undetermined species of whitefly (Aleurodidæ) collected on diseased plants. These experiments carried out under controlled conditions afford evidence which, with my failure to detect a visible parasite, justifies the inclusion of this disease in the virus group.

A condition of the tobacco plant in which the leaves are curled has been reported to occur in most of the tobacco-growing districts of South and East Africa. It is uncertain, however, whether the condition of the plants in any of these regions is due to the same

cause as that which I have studied at Amani. Doubtless several forms of leaf-curling occur, attributable to different causes. Workers in South Africa have recognised two types; one, 'curly-leaf', shown by them to be an hereditary abnormality, and a second, 'crinkly-dwarf', of unknown cause.[1] Their description of 'crinkly-dwarf' agrees well with the Amani disease. Roberts [2] attributed a leaf-curl of tobacco in Southern Rhodesia to injury by a capsid bug. Other workers have regarded leaf-curling as a reaction to unfavourable soil conditions. It is possible that the investigation of some of the curly-leaf conditions elsewhere upon the lines which I have followed may demonstrate their identity with the Amani disease.

It is a matter of interest that another whitefly-transmitted virus disease, the leaf-crinkle of cotton, is also characterised by leafy outgrowths from the lower surface of the leaves.[3]

H. H. STOREY.
East African Agricultural
Research Station,
Amani, Tanganyika Territory, June 17.

[1] *Rept. of Proceedings*, Pan-African Agricultural and Veterinary Conference, Pretoria, 1929, p. 91.
[2] Roberts, *Bull. Ent. Res.*, **21**, pp. 169-183.
[3] Kirkpatrick, *Bull. Ent. Res.*, **21**, pp. 127-137.

Intensity Anomalies in Rare Gas Spectra.

IN Paschen's analysis of the neon spectrum, and in Meissner's analysis of the argon spectrum, there occur curious irregularities in the d-term sequences, and similar deviations are shown in the spectra of krypton and xenon investigated by Meggers, de Bruin, and Humphreys.

An extension of the system of d-terms in rare gas spectra, to be published elsewhere by one of us (E. R.), has shown intensity irregularities running parallel with the deviations in the term values. The argon spectrum will serve as an example.

The two terms 3302·90 and 1828·40, the classification of which has hitherto been uncertain, are now, due to the observation of several new combinations, definitely classified as $6d_3$ and $8d_3$. These two terms deviate strongly from the Ritz formula. Comparison was then made of the intensities of the lines in the series $2p_{10} - md_5$ and in $2p_{10} - md_3$, which for $m = 5{\cdot}7$ and 9 are about equally strong, but for $m = 6$ and 8 the combinations are found to be much weaker with d_3 than with d_5. That is to say, intensity anomalies take place for those terms where the greatest deviations from Ritz's formula occur. Exactly the same thing is found in the spectrum of krypton.

In a theoretical interpretation of the origin of these term anomalies a study of the intensity anomalies is certain to play an important part. Therefore one of us (H. S.), engaged in photographic intensity measurements in rare gas spectra, has undertaken quantitative measurements also for the mentioned combinations.

The following intensity ratios indicate the type of deviations which are found:

$$\frac{I(2p_{10}-5d_3)}{I(2p_{10}-5d_5)}=\frac{1}{1}\quad\frac{I(2p_{10}-6d_3)}{I(2p_{10}-6d_5)}=\frac{1}{6}\quad\frac{I(2p_{10}-7d_3)}{I(2p_{10}-7d_5)}=\frac{1}{1}$$

Further measurements are in progress.

We are indebted to Prof. Bohr for his interest in this problem, and one of us (H. S.) has had the privilege of a fellowship from the American-Scandinavian Foundation.

EBBE RASMUSSEN.
HUGO SWENSON.
University Institute for Theoretical
Physics, Copenhagen, June 25.

Effect of Pressure on Raman Spectra.

THE influence of its neighbours on the rotation and vibration states of a molecule in a gas is due partly to the general intermolecular field and partly to actual collisions. From the kinetic theory of gases, it is known that the mean frequency of collisions which a molecule undergoes is given by the ratio P/η of the pressure to the viscosity of the gas. The perturbing influence of collisions on molecular rotation may be expected to be small so long as this frequency is low, but would become considerable when the mean frequency of collision approaches a value comparable to that of molecular rotation. By taking P/η to be equal to the frequency of rotation of the molecule in the one-quantum state, we may obtain an estimate of the pressure at which the distinctness of quantisation of the different rotations would disappear. In this way, the following estimates of pressure in atmospheres at 30° C. are obtained for the different gases: Hydrogen, 450; methane, 48; nitrogen, 29; oxygen, 25; acetylene, 10; carbon dioxide, 5; hydrogen chloride, 128; ammonia, 83; nitric oxide, 25.

These estimates agree remarkably well with actual observations of the pressures above which the discrete lines in the rotational Raman spectrum of the gas disappear and are replaced by a continuous spectrum. I have found that oxygen and nitrogen show the rotational fine structure at a pressure of 20 atm., while only an unresolved band is obtained at a pressure of 30 atm. Houston and Lewis report a similar result for carbon dioxide above 5 atm. pressure.[1] In the other cases, the calculated pressures are uniformly greater than those at which Rasetti and others have actually succeeded in recording the rotational fine structure. It is not improbable that in the case of polar molecules the fine structure might disappear at somewhat lower pressures than those given above, in consequence of the intermolecular fields.

S. BHAGAVANTAM.
210 Bowbazar Street,
Calcutta, India,
June 22.

[1] *Proc. Nat. Acad.*, vol. 17, p. 229; 1931.

The Slow Combustion of Methane and Ethane.

NOT knowing on what experimental evidence (if any) Dr. Mardles [1] bases his conclusions about the initial 'peroxidation' of methane and ethane to 'methyl hydrogen peroxide' and 'ethyl hydrogen peroxide' respectively during slow combustion in air, may I inquire whether (and, if so, how) he has isolated and identified any such substances so produced? For, as was pointed out in the paper on "The Slow Combustion of Ethane" recently published by Mr. S. G. Hill and me,[2] there has been, so far, no real experimental proof about the initial 'peroxidation' of the hydrocarbons in question in slow combustion; although, as was then shown, the fact that in the case of ethane some slight 'peroxidation' of the intermedially formed acetaldehyde may occur has perhaps confused the issue in some minds and misled some observers.

All I can testify is that, as the outcome of many years' careful experimental study of the combustion of methane and ethane over a very wide range of conditions in my laboratories (both earlier on in Manchester and more recently here in London), no evidence whatever of an initial 'peroxidation' has yet been discovered; on the contrary, the weight of cumulative evidence is so overwhelmingly in favour

of an initial 'hydroxylation' that I still regard it as the best interpretation of the known facts.

Moreover, when in due course the details are published of the further experiments recently carried out here (1) by Dr. D. M. Newitt and Mr. A. E. Haffner on the pressure-oxidation of methane and (2) by Mr. R. E. Allum on the kinetics of its slow combustion at atmospheric pressure, I think there will remain but little room for doubt about methyl alcohol being the initial product, unaccompanied by any vestige of a hypothetical 'peroxide'.

If, however, Dr. Mardles can adduce satisfactory experimental proof of his supposed initial formation of 'methyl-hydrogen-peroxide' during the slow combustion of methane, by actually isolating and identifying it among the products, there will be grounds for reconsidering the matter, but otherwise not.

WILLIAM A. BONE.

Imperial College of Science,
London, S.W.7, July 20.

[1] NATURE, July 18, p. 116.
[2] *Proc. Roy. Soc.*, A, **129**, p. 424.

Unusual Lightning.

ON the night of July 12 we witnessed a display of atmospheric electricity which was sufficiently unusual to merit description.

The display was confined to one cloud, low on the horizon in the direction north by west, and apparently at a considerable distance. To one of us, observing from 10.15 P.M. to 10.30 P.M., the phenomena appeared as flame-coloured discharges which recurred in the cloud with considerable regularity at intervals of about a minute and were remarkable for their duration, which was sometimes as great as one second. No thunder was audible.

To the other, observing independently from 10.30 P.M. to 11.30 P.M., the discharges seemed to have their origin in the upper part of the cloud, for each one showed the dark upper edge of the cloud in strong relief: glows of flame-coloured light shone upward and illuminated higher clouds. Sometimes the glow would extend over the whole cloud, sometimes only over a portion of it, and occasionally would start at one end of the cloud and move to the other before being extinguished. The discharges occurred at intervals of one to one and a half minutes, and frequently lasted for a second, in marked contrast to the apparent instantaneity of forked lightning.

Dr. Simpson has suggested that the description tallies well with that of *Flachenblitz*, which appears to be a silent discharge over the surface of a cloud. In his Robert Boyle Lecture (1930) he states that very little is known about this form of discharge and that it is probably due to a kind of St. Elmo's Fire over the whole surface of a cloud.

There is no mention of this form of lightning in the "Encyclopædia Britannica".

H. E. BECKETT.
A. F. DUFTON.

Building Research Station,
Garston, Herts, July 20.

Valency and Diamagnetism of Titanium in the Tetrachloride.

TITANIUM (atomic number 22) is known to be paramagnetic. It shows anomaly in that its paramagnetism after decreasing from $1{\cdot}6 \times 10^{-6}$ at $-170°$ to $1{\cdot}25 \times 10^{-6}$ at $-80°$ becomes constant. All its compounds so far studied are also known to be paramagnetic; TiO_2, Ti_3O_5, TiS_2, and Ti_2S_3 having values 0·066, 8·1, 0·56, and 0·91 ($\times 10^{-6}$) respectively, for the specific susceptibility (Int. Crit. Tables).

In a recent paper, Weirl[1] has found by electron diffraction that titanium tetrachloride has tetrahedral symmetry with the titanium atom in the centre and the Ti–Cl bonds, being equally and symmetrically directed towards the corners of a tetrahedron. In this case, the titanium central atom has 18 electrons forming a completed group and the four valency electrons symmetrically distributed with respect to the centre, and titanium chloride must be expected to show diamagnetism as contrasted with other compounds of titanium.

An accurate investigation of titanium chloride (a strongly fuming liquid) was made with a sensitive Curie balance, with quartz suspension and retorsion head. The liquid was contained in thin sealed capsules, correction being applied for the latter. The liquid was found to be diamagnetic with a value ($-0{\cdot}287 \times 10^{-6}$) for the specific susceptibility at 35° C.

This suggests that the paramagnetism of the element titanium is due to the two pairs of valency electrons being in different orbits and giving rise to a resultant paramagnetism, and similarly in the compounds of titanium, the paramagnetism in the compounds is due to the unsymmetrical nature of the valency links. When all the valency links are symmetrically distributed as in titanium tetrachloride, the paramagnetism disappears.

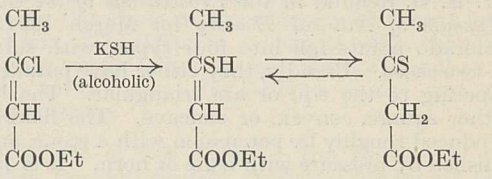
V. I. VAIDHIANATHAN.

Department of Physics,
F.C. College, Lahore,
June 24.

[1] *Ann. der Phys.*, vol. 8, ser. 5; 1931.

Synthesis of Ethyl Thio-aceto-acetate.

WITH the view of investigating the negative character of the methylene group due to the proximity of : C : S group, Mr. E. K. Mitra, Sir T. N. Palit research scholar, working in my laboratory, has succeeded in effecting the long-looked-for synthesis of ethyl thio-aceto-acetate in the following way:



The mercaptan at the moment of its formation tautomerises as indicated above.

The so-called thio-ester described in the text-books is really diacetoacetic ester sulphide, as is evident from the mode of its preparation and reactions. The new ester behaves exactly like ethylacetoacetate in its reactions towards hydrazines, hydroxylamine, aromatic amines, etc., with the formation of heterocyclic ring compounds. It undergoes Grigniard's, Reformatsky's, and Michael's reactions, resulting in a vast series of interesting compounds. In Knoevenagel's reaction, however, the course taken up is a novel one, giving rise to the formation of thio-aldehydes, hitherto almost unknown in a very good yield. The characteristic behaviour of these true thio-aldehydes and their relationship with ordinary aldehydes are also being closely studied. A detailed account of the investigation will in due course appear in the *Journal of the Indian Chemical Society*.

P. C. RÂY.

University College of Science and
Technology,
Calcutta, June 6.

Research Items.

South Russian Steppe Graves.—The chronological significance of the 'Copper Age' graves in the Pontic steppes is discussed by Prof. V. Gordon Childe in *Man* for July. Both their relative and absolute age are ambiguous. Recently, A. W. Schmidt, of Leningrad, who distinguishes three chronological stages, has assigned the 'Early Kuban phase' to the first half of the third millennium B.C. and the 'Middle Kuban' to 2300–1600 B.C. A. M. Tallgren, on the other hand, would abbreviate the first phase (Maikop and 'royal kurgans') and synchronise it with the Danish Passage-Graves epoch with a date rather after 2000 B.C. The later phase ('catacomb graves') would be parallel to the Long Stone Cists of Denmark, and occupy from 1800 to 1400 B.C. Recent excavations in Denmark and Macedonia have produced decisive evidence. A hammer-headed pin of bone or metal assigned to the Copper Age of the Middle Kuban phase is peculiar to South Russia from the Dnieper to the Caspian. A bone hammer-pin, with all the peculiarities of the South Russian type, was recently found in a passage-grave on Lolland. It belongs to the second of the four phases of the Passage-Grave epoch. Further, an unfinished stone battle-axe of a peculiar form has been discovered in the early Macedonian stratum at Hagios Mamos in Chalcidice. It agrees in smallest detail with one from a grave at Konstantinova near Piatigorsk, associated with grave goods typical of the Middle Kuban phase. Middle Kuban and early Macedonian thus overlap. The early Macedonian is dated about 2000 B.C., which confirms both the third millennium for the Middle Kuban and about 2000–1800 B.C. for the Passage-Grave period in Denmark.

Colorado and Folsom Points.—Flaked points from Colorado, New Mexico, Texas, and Wyoming, which differ in appearance, technique, shape, and quality from those usually found in collections of Indian artefacts, are the subject of a typological study by Dr. E. B. Renaud in the *Proceedings of the Colorado Museum of Natural History* for March 1931. The Colorado points fall into four types, with sub-types in two cases. Broadly, they either have parallel sides tapering to the tip, or are triangular. The base is either square, convex, or concave. The flaking was produced roughly by percussion with a stone, and was finished by pressure with bone or horn. It is on both sides, and some specimens have a marginal retouch. The flaking is parallel and oblique, in some cases extending from edge to edge, in others proceeding from both edges, leaving a central ridge. The flaking of the base was effected as a means of thinning the implement to facilitate hafting. It is also significant, as it leads by stages up to the highly specialised Folsom type. The characteristic Folsom point has as its type station Folsom, New Mexico, but it is also found in Colorado, Wyoming, and elsewhere in New Mexico, presumably being a product of the same culture as occurs at Folsom. Others from these areas approximate to the type. The Folsom point is narrower at the base, which is deeply concave, than at the maximum width of the blade. The characteristic feature, however, is the longitudinal groove. It appears to be the climax, or a late stage, of evolution; but although the Colorado points leading up to it would appear morphologically older, there is no objective proof of their greater antiquity. The Folsom points are said by competent geologists and palæontologists to come from Pleistocene gravels, in which they are associated with a large and extinct species of bison and other fossils. Points from Hugo, Carson, and other sites in the Sandy Rush Creek district, are from 'blow outs', in which, owing to the action of the wind, all objects, irrespective of age, are lowered to a common level.

Bodily Position in Restful Sleep.—It is probably not usually appreciated how much movement takes place during sleep. Investigations at the Mellon Institute, Pittsburgh ("Bodily Positions in Restful Sleep." By Dr. H. M. Johnson. Pp. 24. Pittsburgh: Mellon Institute of Industrial Research, 1931), show that the healthy adult during deep sleep makes some gross change of bodily position on an average every 7–8 minutes. Every sleeper has a repertory of a dozen or more very different poses in which he takes his rest. On any typical night he will make use of all, or nearly all, of this dozen, changing from one to another twenty to sixty times, according to his sensitivity to various kinds of bodily irritation. Among different persons, some have a strong preference for supine positions, others favour prone ones. By means of an ingenious device, photographs were obtained of every change of position assumed by a sleeper during a night, and show an extraordinary range of positions.

Land Birds of Sonora, Mexico.—A study of the birds of Sonora, represented by some 4000 skins, shows that the area, which lies east of the Gulf of California, contains four faunal districts or differentiation areas. The Colorado desert district marches with an extension of the eastern plains area, having many characteristic races. On the other hand, the Tiburon Island district is poorly characterised as regards endemic bird life, although within the most southerly district, Alamos, a great number of resident land birds as well as several littoral species have developed local races. The bird population upon which these districts have stamped local characters is derived from three distinct sources. Most abundant are southern species, which here reach the limit of their range; then follow local representatives of wide-ranging species; and poorest in numbers are birds of northern derivation, also at the extreme of their range. This faunal aggregation forms a strong contrast with that on the other side of the Gulf of California, where, instead of the greater portion of the avifauna, only one species (*Hylocharis xantusii*) possesses southern affinities (A. J. van Rossem in *Trans. San Diego Soc. N.H.*, vol. 6, p. 237, 1931).

Polyembryony in a Braconid Parasite.—*Technical Bulletin* No. 230, March 1931, of the United States Department of Agriculture is devoted to an article by H. L. Parker, who shows that the braconid, *Macrocentrus gifuensis* Ashm., which parasitises the European corn borer in France, undergoes polyembryonic development. While polyembryony is well known in insects, among certain of the Chalcidoidea and Proctotrypoidea, Dr. Parker's studies bring to light the first proved example of its occurrence among Ichneumonoidea. The general details of the process, and the rôle played by the polar bodies, are very similar to what is already known in other groups. There is, however, no proliferation of the host tissue around the embryos to form a definite cyst as in *Encyrtus*. The maximum number of individuals arising from the division of a single egg appears to be eight or ten. Most of the host corn borer larvæ contain several eggs of the parasite owing to the repeated oviposition by the female *Macrocentrus*. As a result, there are usually many more parasite larvæ and embryos present in the host than it can nourish. These supernumerary embryos and larvæ become

destroyed during feeding and growth. The *Macrocentrus*, it appears, destroys up to about thirty-six per cent of its hosts, but its efficacy in this respect seems to vary a good deal in different regions of France. The author discusses the most favourable conditions under which consignments of the parasite should be imported and colonised in the United States, as an auxiliary measure in the biological control of the corn borer.

Illumination and Tree Growth.—The *Scientific Proceedings* of the Royal Dublin Society, vol. 19 (N.S.), No. 45 (Oct. 1930), print Part 3 of the investigations on "Photo-electric Measurements of Illumination in Relation to Plant Distribution", by W. R. G. Atkins and Florence A. Stanbury. This part deals with "Certain Spruce, Larch, Oak and Holm Oak Woods". In Part 2 (1929) a description was given of measurements of illumination made with portable galvanometers. The intensities of the illumination in four different types of woodlands were measured, and a study of the floras found at the shaded sites makes it possible to correlate light intensity with plant distribution. The effect of different densities of shade on the ground flora was examined by obtaining data from different woods, such as *Picea excelsa*, pure stand; *Larix europœa*, nearly pure stand; mixed *Quercus ilex*, where undergrowth of *Hedera* prevailed beneath *Quercus robur*; but under *Ilex aquifoliumi* with much reduced light, nothing grew. These investigations should prove of considerable interest, and might not be without their importance to the forester; for example, investigations to show the intensity of the light required for the optimum development of seedlings of the above-mentioned species under the shade of the parent trees.

Marine Algæ from the Pacific.—In a paper entitled "Marine Algæ of the Revillagigido Islands Expedition in 1925" (*Proceedings* of the California Academy of Sciences, fourth series, **19**, 11, Dec. 1930), W. A. Setchell and N. L. Gardner record and describe a large number of Algæ collected by Mr. Herbert L. Mason on the expedition sent out by the California Academy of Sciences. With these are included a few previous records of Algæ from Guadalupe Island, one of the principal islands of the group. The climate is fairly cold, owing to the prevalent north-west winds, and the flora is northern for the latitude and somewhat similar to that of California and lower Oregon, the chilling, at least of the shallower waters, affecting the distribution of the Algæ. One hundred and twenty-five species are recorded, including a few from near the mainland of Mexico; 98 occur on Guadalupe Island and 30 on Clarion Island (the most westerly). Only 5 species are common to both. Two new genera and 29 new species are described. As at present known, 127 species are restricted to Guadalupe and 7 to Clarion Island. The remainder occur also in various parts of the world. An interesting case of distribution is that of *Halothrix lumbricalis*, which occurs locally, always in May only, in western Europe, north-eastern North America, and Guadalupe Island. Good illustrations are given in 15 plates at the end of the paper.

Supernumerary Cell Divisions in Maize.—Last year Mr. George W. Beadle described a variety of maize showing asynapsis, or failure of the chromosomes to pair in meiosis. He now gives an account of a variety in which supernumerary cell divisions occur in connexion with the pollen development (*Mem.* 135, Cornell Univ. Agric. Exp. Sta.). In meiosis the chromosome behaviour is much like that of haploids, that is, the chromosomes do not pair, but are distributed irregularly in both meiotic divisions without splitting. Following these, further mitoses of a similar kind occur, giving rise to as many as 32 cells, some of which frequently have a single chromosome. The pollen of such plants is completely sterile, and very few seeds are produced if the strain is pollinated from the normal. The variety is called *polymitotic*, and the condition is inherited as a simple Mendelian recessive in crosses. It is found to belong to the *Y-Pl* linkage group, and not to be allelomorphic with the gene causing asynapsis. But it is inherited as a sporophytic character, and this can only be accounted for by assuming that the dominant influence of the normal condition continues in the cytoplasm of the young gametophytic cells—cytoplasm which they have received directly from that of the pollen mother cells, in which some stimulus to further cell divisions is present.

Pre-Cambrian Tillite in South-West Africa.—In the *Trans. Geol. Soc. S. Africa*, **34**, pp. 1-17, 1931, Dr. T. W. Gevers describes a tillite from the Pre-Cambrian complex of western Damaraland, which he considers may be even older than the Huronian cobalt tillite of Canada. The tillite occupies a horizon between the quartzite and marble series of the Damara system, the latter being provisionally regarded as equivalent in age to the Swaziland system of South Africa. It has a remarkable resemblance to the Dwyka tillite; is unbedded and unassorted through a thickness of 500-600 ft. and contains numerous faceted boulders and pebbles. The matrix may be argillaceous (now biotite-schist) or arenaceous (now a dense greenish black siliceous rock). Rapid alternations of these are suggestive of varves. The lithological succession as a whole seems to indicate eight or nine major advances of the ice front. In some horizons the quartzites are ripple-marked by currents that flowed from the west. The tillite has already been proved over an area of 5000 square miles, and future exploration is likely to extend this very considerably. The paper includes a tentative classification of the Pre-Cambrian rocks of South-West Africa. The Nama system is regarded as doubtfully Cambrian in accordance with recent fossil discoveries. The Damara system is older than the 'older' gneissose granites, but there are still more ancient rocks: the Pre-Damara gneiss and the Abbabis system.

The Nature of the Aurora.—The *Bulletin* of the American Physical Society published on June 5 contains a note by J. Kaplan on the production of the auroral spectrum in discharge tubes. This has been accomplished by working with air at low pressures (less than 10^{-3} mm. mercury), running the discharge continuously for long periods, and observing it in particular at those periods when after admitting fresh gas to replace that which disappeared during the passage of the current the discharge was again flickering and on the point of being extinguished from lack of gas. Apparently the effect for running a discharge for long periods is to modify the surface of the tube in some way that prevents it destroying the active atomic systems which are responsible for the curious features of the auroral spectrum. From the analogy, Dr. Kaplan draws the conclusion that auroral displays are electrical discharges at low pressures under conditions which are ideal for the production of the nitrogen after-glow. The auroral green line and certain allied lines which arise from atomic oxygen have, of course, been found previously in discharge tubes, but it appears that Dr. Kaplan has succeeded in reproducing the novel features presented by the nitrogen bands in the aurora for the first time.

Spectrum of Carbon Disulphide Flames.—An investigation of the flame of carbon disulphide burning under various conditions is described by Prof. A. Fowler and W. M. Vaidya in the July number of the *Proceedings of the Royal Society*. The band spectra associated with sulphur and many of its compounds are fairly well known, although they are not as yet completely analysed, and it was thought that examination of the light should give information about the chemical processes involved. The ordinary 'hot' flame shows principally the bands of the S_2 molecule. Some of these appear normally not in emission but in absorption, although they can be made to appear in emission by slightly altering the conditions of combustion. Emission bands of the substance SO, which is not known as a chemical individual, appear faintly, whilst if the carbon disulphide is burnt in a chimney, absorption bands of the dioxide (SO_2) also appear. Carbon disulphide can give a colder or 'phosphorescent' flame, and it was already known from the work of H. J. Emeléus that this had a different spectrum. In this, Prof. Fowler has now identified bands of SO and CS, the former being relatively much stronger than in the hot flame. Some preliminary measurements have also been made of a new ultra-violet group of bands, not found in flames, which have been provisionally ascribed to carbonyl sulphide (COS). The spectroscopic evidence gives no evidence for or against the presence of peroxides or carbon monoxide in the flames, but is not completely conclusive.

Rhenium Compounds.—The selenides of rhenium have not previously been described, and considerable uncertainty existed as to the sulphides higher than the disulphide. Briscoe, Robinson, and Stoddart, in the June number of the *Journal of the Chemical Society*, describe experiments which show that the heptasulphide, Re_2S_7, is precipitated incompletely by hydrogen sulphide from ammoniacal solutions of potassium per-rhenate. It is a black amorphous powder, formerly described as ReS_2 or ReS_3. The disulphide, ReS_2, is obtained as a black powder by heating rhenium to redness with excess of sulphur in a Rose crucible under hydrogen sulphide, or by heating the heptasulphide to redness in a vacuum. No evidence was obtained of any sulphide between Re_2S_7 and ReS_2 when the heptasulphide was heated to 250° in an atmosphere of nitrogen. The heptaselenide was obtained in the same manner as the heptasulphide by substituting hydrogen selenide for the sulphide. It is a black powder. On heating in a vacuum at 325°-330° for nine hours it loses selenium, leaving the diselenide stable in air and not attacked except by strong oxidising acids.

Cellulose Lacquers.—The solvents and plasticisers used in the modern manufacture of cellulose lacquers are described in the *Chemical Age* for June 27 by T. H. Durrans. The world's consumption of solvents is estimated at 100,000 tons annually, acetone and the acetates of ethyl, butyl, and amyl being most largely used. Most of the largely used solvents are produced by bacterial fermentation, although there have recently been striking advances in synthetical as well as fermentation processes. The range of commonly used resins and plasticisers is also restricted, the main consumption of plasticisers being confined to triacetin, benzyl alcohol, triphenyl and tricresyl phosphates, and the phthalic esters, whilst ester gum and its derivatives are the only resins universally used. The plasticiser is a most important constituent, the nature and quality of the film depending upon it to a very large extent. The plasticiser is, as Dr. Durrans says, "the master of the cellulose ester film and controls its career throughout its life". A property which is receiving much attention is that of toxicity: unsuspected dangers have been disclosed, as, for example, in the case of glycol chlorhydrin. The same issue of the *Chemical Age* contains other interesting articles on solvents, from which it appears that butyl alcohol and acetone are obtained in America by the fermentation of corn starch, the hydrogen and carbon dioxide evolved being converted into synthetic methyl alcohol, the excess of carbon dioxide being turned into solid, used as a refrigerant under the name of "dry ice". Non-inflammable solvents made on the large scale in England include chlorinated acetylenes (trichlorethylene, perchlorethylene, tetrachlorethane), used for oil extraction, dry-cleaning, degreasing wool, and textile scouring. Artificial resins include the coumarone resins, polymerised from coumarone, a constituent of coal tar.

Astronomical Topics.

New Comet, 1931*b*.—*U.A.I. Circ.* No. 327 announces that a new comet was discovered by Mr. Nagata, and confirmed photographically by Mr. Moore at Mt. Wilson; the following rough position is given:

U.T.	R.A.	N. Decl.
July 17^d 16^h 26^m	10^h 41^m	9° 48′

The comet is an evening object, too low in the west for convenient observation. There is no information about motion or brightness. The news was transmitted by Mr. van Maanen and Prof. Shapley.

Rapid Current on Jupiter.—The *Observatory* for July contains a report of Mr. B. Peek's paper to the Royal Astronomical Society in which he examined the outbreak in 1929 of rapidly moving dark spots on the south edge of the North Temperate Belt. He noted that there were similar outbreaks in the same zone in 1880, when the late Mr. W. F. Denning found a rotation period of about 9^h 48^m, and in 1891, when Prof. Barnard found a period of 9^h 49^m. The spots of 1929 had a similar short period, though it grew longer towards the end of the year, when the spots were fainter. The period found is even shorter than the average period for the planet's equator (9^h 50^m 30^s) and very much shorter than the average for the temperate zone (9^h 55^m 40^s). Mr. Peek thinks that there may be a permanent rapid current in this region of the planet, and requests that it should be kept under regular observation.

Star Density in Different Galactic Latitudes.—*Mon. Not. Roy. Ast. Soc.* for May contains a paper by Mr. P. J. Melotte which gives the results of star-counts in forty Kapteyn areas photographed at Greenwich with the 26-inch refractor.

The following abridgment of his table gives the logarithm of the number of stars per square degree in the different zones down to the limiting magnitude stated:

Limiting Magnitude.	Log. of No. of Stars per Square Degree. Gal. Lat. 0° to 20°.	Gal. Lat. 20° to 40°.	Gal. Lat. 40° to 90°.
11·0	1·34	1·03	0·87
12·5	1·94	1·63	1·32
14·0	2·58	2·11	1·80

In the lower latitudes the logarithms are greater than those of Seares and van Rhijn by about 0·12; the difference tends to disappear in the higher zone. It will be seen that down to mag. 14 the galactic zone is six times as rich as the polar zone. The ratio steadily increases as fainter stars are included.

Textile Research.

THE report of the proceedings of the Imperial Wool Research Conference, 1930, recently published, contains the recommendations of the Conference, with observations on them made by the Imperial Conference, and the papers and addresses given at the Conference, some of which have already been noted in NATURE. A further paper by Mr. A. Frobisher, secretary of the Wool Industries Research Association, entitled "Textile Research on the Continent", which, owing to the pressure of time, was not read at the Conference, is included as an appendix. This paper gives a brief account of the Deutsches Forschungsinstitut für Textilindustrie at Dresden, about one-third of the activities of which is devoted to wool problems. At these well-equipped laboratories much fundamental research is carried out under the direction of Dr. Krais, as well as the investigation of purely technological problems, such as the strength and elasticity of yarns, resistance of fabrics to friction, fracture, and folding or creasing. At the Institut für Faserstoffchemie, Berlin-Dahlem, under the direction of Prof. R. Oliver Herzog, pure research on textile fibres is being carried out, the equipment for investigation of the ultimate structure of fibres by X-ray methods being very complete. Excellent facilities are provided for research workers, including visitors from other countries.

Numerous papers on fundamental research on wool improvement have also been published by the Institut für Tierzucht und Vererbungsforschung der Tierarztlichen Hochschule, Hanover, although an important function of this institution is the training of students.

Hitherto there has been no institution in Italy engaged entirely on the solution of problems connected with the woollen and worsted industries, although some wool research is carried out at the textile schools. An institute intended mainly for wool investigations is now being built in Biella and this will be financed entirely by the industry. Wool research in Switzerland is carried out at the Experimental Station, St. Gall, where three research workers are engaged on such problems. In France, industrial research work is largely supervised and financed by the National Office for Scientific, Industrial, and Agricultural Research at Bellevue, near Paris, most of the research work being carried out at the Laboratoire des Services Textiles du Conservatoire National des Arts et Métiers, Paris, and at the laboratory at Roublaix.

In Belgium, collaboration between manufacturers and the research laboratories financed by a national fund for scientific research was ensured in 1929 by the formation of a special Bureau of Industrial and Scientific Relations. Under the agreement, manufacturers may submit special research problems connected with their industries to the laboratories, provided the problems are of general interest. In such cases, the direct expenses of the research are defrayed by the manufacturer.

Textile research has been carried on at the Masaryk Labour Institute in Prague since February 1926, and in 1929 an independent Czechoslovakian Textile Institute was founded to advise the industry on the elimination of waste and improve productive capacity. A Research Institute for the Textile Industry has also existed in Reichenberg for the past eight years and a new building is now being erected. This Institute covers all branches of the textile industry and it has recently constructed a special apparatus, the 'rapid lanometer', for measuring the fineness of wool.

A certain amount of wool research is carried out at Delft by the Dutch Government Information Service for the Textile Industry, and also at the textile schools at Enschede and Tilburg, The Ministry of Agriculture of Hungary has recently established a wool research institute; while a considerable amount of research on wool production is being carried out at the Experimental Station for Animal Husbandry, Boguchwala, ad Rzeszov, Poland, under Dr. Marchlevski. Wool research is also being developed at the Jagellonian University at Cracow, and research on sheep-breeding at the Zootechnical Department of the University of Bukarest.

Wool is included in the ambitious scheme of research for the five-year period drawn up by the Central Research Institute for the Textile Industries (Niti), of the U.S.S.R. The wool section had ten research workers during the first year, a number which is expected to reach fifty-six. The Five Years' Plan includes research on all that is fundamental in providing data for a complete reorganisation of the wool industry on scientific lines.

Textile research is being carried on in Great Britain, notably in the Clothworkers' Departments, University of Leeds. A research scheme was established in 1928 with the aid of a special grant from the Worshipful Company of Clothworkers, and the report for the session 1929–30 contains references to work on the elasticity of wool, the elastic properties of wool in organic liquids, the micelle structure of the wool fibre, and the action of caustic soda and sodium sulphide, which has already been published in NATURE or other scientific journals.

The earlier discovery, resulting from the study of the adsorption of water by wool, that the wool fibre is constructed from long-chain protein molecules arranged lengthways along the fibre, has formed the basis of the work of the past session. In addition, the discovery of a method for measuring the scaliness of different wools and hairs marks the first step towards establishing the milling process on a scientific foundation, the surface scale structure of the fibre being responsible for the felting and shrinking of wool fabrics in the milling process. Other technical investigations have related to the thermal conductivity of textile materials and fabrics, the transmission of water vapour through textile materials and fabrics, and the comparison of wool oils and creams.

Progress in the field of textile physics as a result of X-ray methods has already been noted in NATURE for April 11. The crystallographic picture of the molecular architecture of the wool fibre, although incomplete, has already thrown new light on many typical properties which are of great importance in manufacturing processes. Correct interpretations of conditioning, dyeing, and other adsorptive processes have been facilitated and our ideas of all operations involving the elasticity of the fibre have been clarified. The well-known 'permanent set' of wool fibres is a direct consequence of the action of steam on the stretched β-form of wool (and hair) but not on the unstretched α-form. Results of the X-ray investigation of the wool fibre are related to similar investigations on the structure of natural silk, which finds its counterpart in stretched wool and not in normal wool. Accordingly, silk does not show the long-range elastic properties of wool because it is already in the extended state. The X-ray investigations have also been related to the structure of cellulose, and the structure based on ideas current in Germany is considered unsound. The point is of technical interest in relation to mercerisation.

The Carnegie United Kingdom Trust.

THE seventeenth annual report of the Carnegie United Kingdom Trust gives, by way of introduction to its record of the events of 1930, a short general survey of the five years 1926–1930 and a statement of the main heads of policy which the trustees have decided to pursue during their fourth quinquennium, 1931–1935. Their operations range over a wide field, shared now with the Pilgrim Trust, of charitable enterprise in Great Britain and Ireland. They give preference among charitable objects to such as are of an experimental and national character and to schemes which are likely to become self-supporting within a reasonable time, since it was the founder's desire to provide means for fostering a perpetual succession of pioneer enterprises calculated to meet new needs as they arise. The fairy-godmother, in fact, whilst guaranteeing her protégées a fair chance of showing their quality and merits, is careful to disclaim all responsibility for their future maintenance.

The Trust's income of, roughly, £120,000 a year has been distributed since 1925 mainly in grants under the headings: libraries (47 per cent), playing fields and play-centres (21 per cent), rural development, adult education, and music and drama. In their library development work the trustees have exploited to the utmost the possibilities of co-ordination and co-operation, and this policy led to the establishment in December and January last of two regional schemes of the greatest experimental importance, one in the north of England, based on the library of the Newcastle Literary and Philosophical Society and embracing libraries in the four northern English counties; the other serving Warwickshire, Staffordshire, Worcestershire, Shropshire, and Herefordshire, and based on Birmingham City Library. In each area the trustees are meeting the initial cost of creating the necessary union catalogue. If these schemes, after a short trial period, turn out to be on sound economic and administrative lines, the trustees hope to invite the libraries of two or three other areas to adopt the same policy.

To 'special' libraries, including those of many industrial research and other scientific associations, grants amounting to more than ten thousand pounds were paid last year. These, in return, have made their collections available to the general public on application from the National Central Library. The Association of Special Libraries and Information Bureaux, which has enjoyed the financial support of the Trust during the six years of its existence, has recently decided against a projected amalgamation with the Library Association—a decision involving, the trustees observe, competition and possible overlapping with the university and research section of the Library Association.

The Trust's playing-fields policy, inaugurated in 1927 with an allocation of £200,000 spread over four years, has been carried into effect in collaboration with the National Playing-Fields Association. It has aimed at stimulating and encouraging local effort, and its success may be gauged by the fact that already 356 grants, varying in many cases from only one-tenth to one-sixth of the total cost, have sufficed to enable some 5000 acres to be preserved permanently for the playing of organised games. Apart from this playing-fields programme, the trustees have not during the past year been pursuing any concerted policy for ameliorating the physical welfare of the masses, but they have offered a grant of £30,000 for the erection of a Physical Training College for Men Teachers at Leeds and have helped the National Council of Girls' Clubs to employ two physical training instructresses. The main feature of the college will be a one-year course based on the principle that physical instruction is better given by teachers who also take part in the ordinary work of the school than by specialists with no other qualification and with little, if any, hope of being usefully employed after they reach 40–45 years of age. The Girls' Clubs instructresses conduct short intensive courses in large towns, giving special attention to instruction in the organisation of team games for clubs with limited playing spaces. The experiment is an entirely new one and the results so far are reported to be most encouraging.

A new policy in reference to public museums has recently been decided on by the trustees. Its main feature is a demonstration in public museums, in small towns, designed to show what can be done at a very small cost to make them interesting and educationally valuable. The amount set aside for this purpose is £7000, and will be available solely for reorganisation purposes, in general accordance with the recommendations contained in the report prepared for the Trust by Sir Henry Miers and published in 1928, on "Public Museums of the British Isles". The trustees are also examining the possibility of encouraging the circulation of museum exhibits from urban or county centres to village schools and institutes, and, as a preliminary step, will assist the Museums Association to hold an exhibition of suitable objects, cases, etc.

Appended to the report are useful supplementary notes on the National Central Library and branches, regional library schemes, village halls, and rural community councils.

Atomic Synthesis and Stellar Energy.

By Dr. R. D'E. ATKINSON, Rutgers University.

SOME time ago F. G. Houtermans and the present writer investigated the possibility of synthesis of elements, in stellar interiors, by the wave mechanics process of penetration of nuclei by protons.[1] The theory was not strictly correct, and various modifications have been proposed since, of which the theory of Wilson [2] is perhaps the most important; all theories, however, lead to a probability of proton penetration having the same exponential dependence on both the temperature, T, and the atomic number, Z. The importance of this factor far outweighs that of the multiplicative forefactor which alone is different in the different theories, and it seems therefore desirable to discuss somewhat more fully the consequences of the assumption that any of these theories will give the right order of magnitude for the temperature at which synthesis will occur in large amounts. The effect of the exponential is roughly to make the synthesis probability vary as T^{20}, or some comparable power, and thus even a change of 1000 in the forefactor does not seriously affect T. The investigation is being discussed fully in the *Astrophysical Journal*, but in view of the interest of the subject at present, and also of the comparative unfamiliarity of the line of attack, a short summary may both appeal to a wider audience and prepare the way for the more detailed treatment.

Direct synthesis of helium from hydrogen is clearly a very unsatisfactory process, but we do not need to assume its existence at all; as in the above paper, we assume that helium is produced entirely indirectly, by the spontaneous disintegration of unstable nuclei that must first themselves be formed. In addition to the known radioactive elements, Gamow's theory of nuclear stability [3] now indicates that we may expect a large number of lighter elements to be unstable if they were to be formed, and in fact we rely mainly on these. For example, if above argon the incorporation of electrons, which we clearly must suppose can occur, is somewhat difficult (and the existence of apparently permanent non-radioactive *isobars* seems to show that it can be extremely difficult), nuclei such as Fe^{52}, Ni^{56}, and Zn^{60} may be formed; according to Gamow, the last of these, and quite possibly all three, should be unstable. After emitting one α-particle, they would again collect four protons and two electrons in such order and at such intervals as they could, combine them into a fresh α-particle, and re-emit this one also in due course. At various points in this cycle they would also have to emit a total of just as much energy as would be set free by the direct synthesis of a helium nucleus; this energy can then be used to maintain the star's radiation. This method of evading the well-known difficulty of the 6-body collision as a source of helium obviously opens up important avenues; it is, however, not at all necessary to regard helium as the final product. In fact, since small Z-values favour synthesis, all the helium formed will be rapidly built up again. The energy developed is roughly the same, however, *per proton consumed*, whatever the products.

Since no other theory proposes a lower temperature for an energy source than ours turns out to do, we may take it that stars will at any rate contract until this process becomes operative; they will then be unable to contract further, since even a small contraction will enormously stimulate the energy development and force them to expand again. Milne's theory seems in this way to be ruled out until such time as the hydrogen supply near the centre has run low.

Rosseland has shown that when there is no great excess of hydrogen, electrostatic forces will tend to drive it from the centre, and the centre is in any case the only place where it is being consumed. Thus in any star a time will arrive when the disappearance of hydrogen near the centre prevents the generation of energy there altogether; the star must then condense towards the degenerate state. It is known that the energy of the white dwarfs may be entirely gravitational if their lifetimes may be supposed to be only of the order of 10^{11} years; in addition to explaining why stars intermediate between white dwarfs and the main sequence seem to be scarce, this theory explains why heavy white dwarfs should be the commonest [4] (the minimum radius is smaller and the square of the mass larger, so that they have very much more gravitational energy available).

So long, however, as hydrogen is present, synthesis should continue. Since, now, the star's mass remains practically constant, its energy generation must remain moderately so, and it is easily seen that this involves an approximate constancy of the helium supply, but with an ever-present possibility of adding a little to it. This is the fundamental condition for stellar stability, and determines the central temperature. For a star to keep control, it must slowly decrease its central temperature, since the number of helium sources is being added to; thus, after an initial contraction to start the process, stars spend probably the greater part of their lives *expanding*. During most of their lifetime the expansion is very slow, and the central temperature at any one mass is almost determinate; this accounts for the main sequence.

The actual value for the central temperature cannot, however, be what this simple theory would indicate. If iron is to be synthesised, a temperature of perhaps 200 million degrees would be necessary, and at this temperature all the light elements would be so readily converted to heavier ones that they could not become abundant at all. With a constant helium supply we can use the ordinary equilibrium law of radioactivity theory, namely, that the amounts of the various elements should be directly as their 'average lives'; the fact that we are dealing with synthesis and not disintegration does not affect the validity of the principle. Since the atomic number, Z, affects the synthesis probabilities, that is, the average lives, exponentially, all light elements ought to be very scarce; oxygen is, however, more abundant than anything except hydrogen, and a number of other elements near it are also at least as plentiful as iron.

In fact, it is easily seen that the most abundant element of all in a star must have an average life (until further synthesis) comparable with the past life of the star itself; otherwise some heavier element would be more abundant. If now we assume the central temperature is so low that oxygen is as long-lived as this, we find that it and the lighter elements are nevertheless abundant enough for their synthesis alone to supply enough energy, and that the actual temperature is about 16 million degrees in the sun. This is in agreement with the figure obtained on Eddington's theory for a polytrope of index about three and constitution rather above 50 per cent hydrogen by weight.

At this temperature there is, however, no synthesis of iron, and thus no further supply of helium, and the process will soon exhaust itself. The difficulty may be overcome by an arbitrary assumption, and it has been found possible to make one that accounts at the same time for the permanence and actual position of the main sequence, and for the relative proportions of all the elements in main sequence stars. The assumption is that there is a second synthesis process, which is more probable than the first when $Z>8$ and has a probability that increases somewhat with increasing Z; it must depend about as extremely on the temperature as the other process. Even if this assumption is wrong, it is probably valuable to have the theory investigated in detail; in point of fact, it does at least lead to a number of correct results.

Oxygen will now certainly be the longest lived element, and the products of synthesis will 'pile up' at and near this value of Z. It is, as a matter of fact, desirable to keep them from adding to the iron group which is supplying the helium, for a constant supply is wanted. The iron group itself must, however, be abundant enough to be in 'equilibrium' with the lightest elements, since it must produce as many α-particles per second as there are helium-lithium syntheses. It is found that the situation which will develop involves a marked minimum between the oxygen and the iron maxima and a marked fall after, say, zinc, in very good qualitative agreement with observation.[3] A consideration of Gamow's theory leads us to expect in addition a maximum among and below the lightest rare earths, and possibly one in the lead region; both are found. Practically the entire range of elements thus shows a qualitative agreement with what the theory requires.

The same will be true of any main sequence star; but since the age of the star at a point when it is, say, half hydrogen is much greater for small stars than for large ones, and the density is also larger in small stars, the central temperature must be smaller in them if oxygen is still to have a long enough lifetime. This is

satisfactory, for Jeans's modification of Eddington's theory does involve a polytropic index varying systematically with the mass in about the right sort of way to produce this effect. Jeans's modification results from using the theoretical Kramers value for the absorption coefficient, and the main reason why it has not been more generally adopted (by followers of Eddington) than it has is probably that the absolute values obtained by Kramers' theory did not seem to fit the facts. When, however, we adopt Russell's high value for the hydrogen content of stars the discrepancy disappears.

The vast majority of the stars are thus accounted for. The main sequence consists of stars built on the Eddington-Jeans model, with central temperatures fairly sharply defined at any one mass and rising very slowly with the mass, and with a constitution very similar to that actually observed; the central temperature seems to be about 16-20 million degrees in the sun. The white dwarfs consist of a roughly parallel band of stars built nearly on the Milne degenerate model, with central temperatures up to about 3×10^9 degrees; they should have about the same constitution except for a shortage of hydrogen at the centre, and will be fainter for a given mass.

In addition to these two main classes we may account for the low density giants. These have a comparatively low central temperature and can only obtain their energy (*a*) if they have a large amount of free helium or unstable atoms already present, or (*b*) if some very light element can also be unstable. In case (*a*) they will not be able to live very long; but if they are very heavy their total lifetimes will be short anyway, and their life in this state may be a fairly large fraction of the total. The wave mechanics formula used shows that a star of mass 30 suns, if 10 per cent of it were helium and 80 per cent hydrogen, could develop enough energy for an absolute magnitude of -6 even at the density of an *M*5 supergiant, with a central temperature of only 4 million degrees. Such stars will, however, be 'overstable', that is, they will be liable to develop pulsations; these are well known to be a common feature of very massive red stars. If they are not very massive, only a small fraction of their lifetimes can be spent in this state, and they would, in addition, have a very large colour index indeed; we should thus scarcely expect to see any. In case (*b*) a long life would be possible, but as synthesis would now certainly result in an immediate increase in the amount of the unstable element, the stars would have to change their central temperatures over a fairly large range during their lifetimes. The unstable element is assumed to be the isotope Be^8, which exists in very small quantities on the earth and probably has in fact a mass defect (referred to helium as a unit) of very nearly zero. Many beryls contain a large and otherwise unexplained amount of helium, and when the idea of the instability of Be^8 was first proposed, Lord Rayleigh at once pointed out the significance of this fact.[6] The 'Hertzsprung gap' and its prolongation between the Cepheids and the *B* stars may be shown to follow if Be^8 has a long life, and its presence on the earth guarantees this. A long life is also in harmony with the Be^8/Be^9 ratio and the He/Be ratio.

A number of other observations may readily be fitted into the theory. We may mention in particular the absence of low density stars at medium and small masses, the occurrence of *R* and *N* types among giants but not among dwarfs, the existence of binaries in which the brighter star is the cooler and less dense, and the fact that the brightest stars in clusters are usually all red or all blue.

The arguments that have been urged in support of the 'long time scale' (10^{13}-10^{14} years) may all be met with some plausibility. In particular the well-known theory of Jeans for the eccentricities of binaries, and similar 'kinetic theory' arguments can all be reconciled with the 'short time scale' (10^{11} years) if the galaxy is expanding as fast as the universe in general is; this expansion (for the universe as a whole) seems to be demanded by the general theory of relativity.

It thus appears that as a result of the wave mechanics on one hand, and the general theory of relativity on the other, the universe may have developed its present complexity of stars and of atoms from an initial state consisting of a fairly dense, nearly uniform, nearly stationary mass of cold hydrogen. This comparatively simple beginning constitutes at least a pleasant ornament, if not an actual support, for our theory. It must, however, be admitted that there are still some serious difficulties; those that have been noticed are discussed in the full account which will shortly appear.

[1] *Zeits. f. Physik*, **54**, 656; 1929.
[2] *Mon. Not. R.A.S.*, **91**, 283; 1931.
[3] *Proc. Roy. Soc.*, **126**, 632; 1930.
[4] Cf. Russell and Atkinson, NATURE, May 2, p. 661, 1931.
[5] Russell, *Astr. Jour.*, **72**, 11; 1929.
[6] NATURE, **123**, 607; 1929.

Empire Travel for British Students.

FOR the past eight years, parties of Canadian undergraduates, numbering from 50 to 150, and representing most of the universities of Canada, have made a summer tour in Europe under the auspices of the Overseas Education League. The party usually leaves Montreal for Glasgow towards the end of June, and spends about a month in Great Britain, visiting such centres as St. Andrews, Edinburgh, Grasmere, Bangor, Stratford-on-Avon, Oxford, Cambridge, London, and the south coast of England. A further fortnight is then spent in Switzerland, Germany, and France, before the party embarks for Quebec. Last year the continental section of the tour included visits to Geneva, Innsbruck, Oberammergau, Munich, Stuttgart, and Paris.

These tours, of which the great educative value is obvious, represent one activity only of the Overseas Education League. Organised in 1910, on a definitely non-commercial basis, by Major Ney, of Winnipeg, the League was originally designed to foster understanding between Canada and Great Britain. Its scope has gradually widened, and now it "seeks to emphasise the significance attaching to citizenship in the British Commonwealth of Nations, to interpret Britain and France to the two great branches of the Canadian people through a closer educational and cultural association, and to develop a consciousness of the rôle of education as a means to international understanding and amity". It organises summer schools of English, French, music, drama, etc., at Oxford, Paris, and other centres; and, in all, some six thousand teachers and undergraduates have taken advantage of its arrangements. The Governor-General of Canada is honorary president of the League, and among other patrons and supporters are the Governor-General of the Union of South Africa, Lord Plumer, the Right Hon. L. C. Amery (honorary vice-presidents), the Primate of all Canada (president), and Major F. J. Ney (vice-president and honorary organiser).

This summer, for the first time, a return visit to Canada of a party of university students from Great Britain has been arranged under the auspices of the League. A group of about twenty men and women students of the University of St. Andrews, representa-

tive of the various years and faculties, will sail for Canada this month in the company of the home-going Canadian undergraduates and various other Canadian parties. Prof. John Read, professor of chemistry in the United College, St. Andrews, will lead the party, and the tour will occupy a period of about five weeks. The visit will be restricted to the eastern provinces, and the party will visit such centres as Quebec, Montreal, Ottawa, Toronto, and Kingston. The return journey from Toronto to Quebec will be made by water via the Thousand Islands. Throughout the tour opportunities will be afforded the members of gaining a first-hand knowledge of the educational institutions, culture, home-life, and resources of the Dominion. The undertaking appears to provide the first instance of an organised visit to a British Dominion by a body of university students from Great Britain, and the evidence afforded by so interesting an experiment should be of particular value.

University and Educational Intelligence.

EDINBURGH.—Dr. Charles McNeil, senior physician in the Royal Edinburgh Hospital for Sick Children, has been appointed to the newly founded Edward Clark chair of child life and health.

LONDON.—On the occasion of the centenary meeting of the British Association in September next, the Senate has decided to confer the honorary degree of doctor of science on the president (General the Right Hon. J. C. Smuts), Sir F. Gowland Hopkins, president of the Royal Society, and on the following former presidents of the British Association: the Right Hon. Lord Rutherford of Nelson, Sir Charles Sherrington, and Sir J. J. Thomson.

THE governing body of the Lister Institute has appointed Dr. Thomas Fotheringham Macrae to a research studentship in biochemistry.

DR. CATHERINE C. STEELE has been appointed lecturer in agricultural chemistry and physics at the Horticultural College, Swanley, Kent, and will take up her duties in September next.

MR. F. N. MOWDAWALLA has been appointed professor of electrical technology in the Indian Institute of Science, Bangalore, in succession to Prof. J. K. Catterson-Smith.

APPLICATIONS are invited for the following scholarships at the Huddersfield Technical College:—The Joseph Blamires research scholarship for research in colour chemistry, the value of which is £100 a year with remission of fees, and the British Dyes' research scholarship for research in colour chemistry, value £75 a year with remission of fees. Further particulars and forms of application are obtainable from the Technical College, Huddersfield.

School Life, issued monthly by the United States Office of Education, announces in its January issue that it is undertaking a new task. Not content with publishing notices of the numerous monographs prepared by the staff of the Office of Education, it is to ransack the offices of all government departments, commissions, boards, and other agencies for whatever is likely to be useful to teachers. The first-fruits of this new policy appear in the forms of a full-page advertisement of the Geological Survey's maps—which, by the way, are available to schools at a discount of from 40 to 60 per cent, as compared with the 25 per cent allowed by the Ordnance Survey of Great Britain—the 'Children's Charter' adopted by the White House conference on 'child health and protection', a prison education scheme, and a list of new government publications useful to teachers. The same issue contains articles on unemployment in the teaching profession, instruction classes for the unemployed, the rise of the land-grant colleges and universities, how the schools deal with individual differences, American educational progress in 1930, and a radio transmission station for the joint use of six State agencies, including the university and the departments of public instruction, health, highways, agriculture, and State conservation, of the State of Wisconsin.

EDUCATION in India in 1928–29 is reviewed briefly by the Educational Commissioner with the Government of India in a pamphlet recently issued by the Government Publications Branch, Calcutta (price 1*s.* 6*d.*). The number of scholars in institutions of all types in 1929, namely, 12,165,839, shows an increase of 3 per cent in twelve months. During the same period, expenditure on education increased by 5 per cent, to Rs. 27,07,32,253. Expenditure on universities and colleges, providing instruction for 94,257 students, amounted to 13·5 per cent of the total expenditure and showed an increase of 13 per cent over the expenditure of the preceding year. The report suggests doubts as to whether this rapidly increasing expenditure is justifying itself by results. Of the University of Bombay, it is recorded that "the average student does not bother to read his texts but is content to learn by heart second-hand opinions on them, gleaned from cheap bazaar cram-books". The University of the Punjab "is burdening itself, and is encouraging the colleges to burden themselves, with a very large number of students who have little or no chance of completing the course successfully and on whom the expenditure of money intended for higher education is very largely wasted". There is similar wastage also in the University of Rangoon. The number of Indian students in Great Britain is now well over two thousand. Including students at universities on the Continent and in the United States of America, the total number who are abroad in one year is not far short of 2500.

COLLEGE and school athletics, as related to the educational process, have been dealt with by the Carnegie Foundation for the Advancement of Teaching in a series of publications, beginning in 1927, of which the latest is its Bulletin No. 26 on "Current Developments in American College Sport". In a preface by the president of the Foundation, Mr. Henry Suzzallo, attention is directed to a principle, said to have been long recognised in America but, to the serious detriment of the product of higher education in that country, not always acted upon, namely: "that final responsibility for the effective administration of American college sport belongs not to the alumnus, the down-town business man, or the newspaper writer, but to university or college officers". Many of the changes summarised in the bulletin point to an improvement in this respect. "At numbers of institutions attempts are clearly being made to modify and ultimately to eliminate certain abuses which have their roots in the prevalent commercialisation of American college sport." In several fields of sport, however, in which colleges have been used by professional sports promoters as training grounds for recruits, public aversion to such practices will need to be aroused to a much higher pitch than it has at present reached before their elimination can be looked for. Meanwhile a notable decrease of undergraduate interest in inter-collegiate athletics has taken place in recent years. Complaints by academic teachers that students' interest in the things of the mind is feeble are less frequently heard, and this is attributed to the introduction into intellectual pursuits of the competitive motives which prove so effective in sport.

Birthdays and Research Centres.

Aug. 7, 1864.—Mr. OSWALD H. LATTER, formerly senior science master at Charterhouse.

An investigation of the action of certain chemical substances in stimulating dormant storage organs of plants to activity—for example, ethylene chlorhydrin in the case of *Gladiolus* corms, potassium sulphocyanide in the case of potato tubers—might lead to valuable results.

Aug. 7, 1886.—Prof. P. G. H. BOSWELL, F.R.S., professor of geology in the University of London, Imperial College of Science and Technology, S.W.

To select for special mention from among the various branches of pure geology, oil technology, and mining geology is not easy in a department where students bring problems from many parts of the world and where more than thirty subjects of research are in progress. Detailed observations on the constitution, arrangement, and fossil contents of strata, for example, must proceed; as also the exploration of unknown or little known regions. By these means alone can we fill in the many gaps in the geological record and discover new links in the chain of life.

It is important, however, that the inductive methods of experimental research should be employed side by side with analytical investigations. Hence our aim at the Imperial College is to continue research on such problems as the rôle of water and other mineralisers in the genesis of igneous rocks and metallic ores; the imperfectly understood processes in the formation of clays; and the natural history of sedimentary rocks, both as a problem in pure geology and in its bearing on the origin of petroleum.

Aug. 8, 1857.—Prof. HENRY FAIRFIELD OSBORN, For.Mem.R.S., research professor of zoology in Columbia University and honorary curator of vertebrate palæontology in the American Museum of Natural History.

I began field study of palæontology in the month of August, 1876. I initiated the field explorations from the American Museum in 1891 and became fascinated with the origin and evolution of the proboscideans in 1899, leading to the Fayum Expedition of 1907, in turn to the increasingly intensive study of the evolution of the mastodont, stegodont, and elephantine divisions, especially since the year 1920, when the text of the Titanothere Monograph was completed and sent to the United States Geological Survey for printing. Both stegodonts and elephants have been close travelling companions of man for at least 1,250,000 years, and recently a most interesting discovery has been made that intensive measurement of the ridge plates of the grinding teeth of the proboscideans promises to afford a new and very precise means of dating not only the stegodonts and elephants but also their companion, hunter, and destroyer, prehistoric man.

Aug. 9, 1880.—Prof. M. GREENWOOD, F.R.S., professor of epidemiology and vital statistics in the University of London.

I am at present engaged on the statistical analysis of data of epidemics occurring in groups of mice, with particular reference to the mechanism and quantitative measure of immunisation against bacterial and virus diseases.

Aug. 10, 1865.—Col. Sir CHARLES F. CLOSE, K.B.E., C.B., C.M.G., F.R.S., chairman of the Palestine Exploration Fund; president of the International Population Union; president of the Hants Field Club; formerly president of the Royal Geographical Society.

Three groups of subjects are now of special interest to me. Now that Great Britain has the mandate for Palestine, all possible help should be given to the Palestine Exploration Fund and the British School of Archæology in Jerusalem; and it is most desirable that the headquarters and museum of the Fund should become a real centre and focus of information with regard to the history and archæology of Palestine. Secondly, it is to be hoped that the International Map of the World will make more rapid progress; though much has been done, some countries are lagging behind. In a similar geographical field, a comprehensive English text-book on map projections is badly needed. The admirable 'Germain' is much out of date. Thirdly, all interested in the subject should assist the International Union for the Study of Population Problems and the British National Committee of the Union. The Union is not propagandist and its work is purely scientific.

Aug. 11, 1895.—Dr. C. D. ELLIS, F.R.S., fellow of Trinity College and lecturer in physics in the University of Cambridge.

I am engaged in investigating the β- and γ-ray type of radioactive disintegration. Recent work has shown that there is a close connexion between the energy differences of the α-particle levels in the nucleus and the frequencies of the emitted γ-rays, and it seems a point of importance to ascertain accurately the intensities of the different γ-rays in order to establish correlation in this connexion also with the α-particles.

A further point of great interest which can be conveniently studied by the same type of experiment is the direct coupling between the nucleus and the electronic system which is shown by the so-called 'internal conversion' of the γ-rays.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 24.—A. W. Conway: The influence of the work of Sir William Rowan Hamilton on modern mathematical thought. Hamilton's mathematical work may be divided chronologically into four groups: optics, dynamics, general, and quaternions. His work on optics is dominated by his idea of the 'characteristic function' and his grasp of the fact that this had application either to a wave or to a corpuscular theory of light, representing principles of least (or greatest) time and least (or greatest) action, respectively, on the two theories. His application of the principle of varying action put the whole of dynamics on a new footing, and his methods are to-day freely used.—Phyllis Clinch: Cytological studies of potato plants affected with certain virus diseases. A histological and cytological study was made of the mosaic diseases of the potato designated simple and interveinal mosaic, crinkle, streak, and aucuba mosaic. The leaf modifications which underlie the mottling arise in part from underdevelopment of the mesophyll, from a reduction in the number and size of the chloroplasts, and from a paler colour of the chlorophyll. In aucuba mosaic the mottling is almost entirely due to the disintegration of the chloroplasts. Intra-cellular structures of the 'X- body' type occur in all the diseases mentioned,

except aucuba mosaic, and in the case of streak only in the early stages. This study tends to emphasise the similarity of all the potato mosaics, except aucuba mosaic, and indicates that streak belongs to the mosaic group.—**W. R. G. Atkins**: Radiation and life. In view of the importance of an adequate degree of illumination for most species of plant and animal life, convenient methods of measuring daylight in various sites on land and in the sea are of considerable utility. Many such measurements have been made by the author and by others using various methods, of which, for general work, the photoelectric cell is, perhaps, the most convenient. Some of the methods used and the results obtained are discussed.

PARIS.

Academy of Sciences, June 8.—**H. Deslandres**: Simple relations between the molecular spectrum and the structure of the molecule. It is shown that apart from any special theory, and working with experimental data only, the molecular infra-red spectrum depends on whole numbers, and may furnish useful indications on the structure of the molecule.—**Georges Claude**: Human respiration in enclosed spaces under reduced pressure.—**Jean Baptiste Senderens**: The comparative hydration of sulphuric acid and of the alkaline bisulphates; its relations with the catalytic activity. The fact that potassium bisulphate treated with air saturated with moisture is hydrated more slowly than sodium bisulphate under the same conditions, is regarded as explaining why sodium bisulphate is a more active catalytic agent towards alcohols than potassium bisulphate.—**Paul Pascal** and **Mlle. Bernheim**: The study of a mode of transformation of calcium cyanamide into cyanide.—**Edgar Baticle**: The probabilities relating to intermittent phenomena of variable duration.—**Alfred Rosenblatt**: The unicity of partial differential equations of the first order.—**C. E. Winn**: The limits depending on the means of Hölder and Cesàro.—**Nikola Obrechkoff**: The summation of Dirichlet's series.—**J. Le Roux**: The invariant expression of the law of gravitation.—**E. Callandreau**: Approximate solutions of the lines of rupture in a pulverent massif.—**Pierre Dive**: The attraction of homogeneous ellipsoids.—**G. Chapas**: The heats of solution of benzoic acid in toluene.—**M. Haissinsky**: The electrochemical and chemical behaviour of polonium in tartaric acid solution. The experimental results are best explained by assuming that the polonium is combined with the tartaric acid in the form of a soluble complex compound, slightly stable and easily hydrolysable.—**Nahmias**: The fluctuation of the path of the α-ray of polonium in different gases.—**Mme. Irène Curie** and **Marcel Lecoin**: A new gaseous compound of polonium. When polonium, deposited on a nickel needle, is heated in a current of nitrogen, practically the whole of the polonium is deposited in the cooler part of the tube. But if the nitrogen is replaced by a mixture of carbon monoxide and dioxide in equal volumes, about one half of the metal appears to be converted into a gaseous compound, possibly a polonium carbonyl similar to nickel carbonyl.—**Georges Allard**: Electrical moments and molecular constitution.—**W. Swietoslawski**: A boiling point apparatus for examining the purity of liquid chemical individuals.—**L. Lematte, G. Boinot, E. Kahane**, and **Mme. M. Kahane**: The use of a nitroperchloric mixture for the estimation of silica in vegetable substances. Details of the method, for which both rapidity and accuracy are claimed, are given.—**Sou Phou Ti**: The action of ethylmagnesium bromide on *N*-diethylmonochloracetamide. An unusual transposition takes place in this reaction, the alcohol produced proving to be $(C_2H_5)_2 . N . CH_2 . C(OH) . (C_2H_5)_2$. Suggestions for the probable course of the reaction are given.—**J. Hock**: The synthesis of some derivatives of arylacetic and β-arylpropionic acids.—**Raymond Delaby** and **Mme. S. Guillot-Allègre**: The α-β-ethylene aldehydes with a linear chain.—**Agostino Puppo**: The storm of July 24, 1930, in the Treviso-Udine district. The damage done by this storm, stated to be the most violent ever observed in Europe, is described. It included destruction of houses, high tension cables, animals, and trees. Human beings were lifted up and carried several hundred metres. The maximum velocity was calculated at 80 metres per second.—**A. Duparque**: The microscopic structure and origin of coking coals and bituminous coals.—**P. Lavialle** and **P. Jaeger**: The origin of fruit in its relations with pollenisation in *Knautia arvensis*.—**Fernand Moreau** and **Mlle. C. Morwzi**: Experimental researches on the formation of the perithecium in *Neurospora*.—**C. Charaux** and **J. Rabaté**: Contribution to the biochemical study of the genus *Salix*. A new glucoside, salipurposide, hydrolysable by emulsin, extracted from the bark of *Salix purpurea*. The new glucoside has the composition $C_{21}H_{22}O_{10}$; on hydrolysis it gives glucose and a substance salipurol, $C_{15}H_{12}O_5$.—**Pierre Gavaudan** and **Robert Cazalas**: Some teratological phenomena observed during the spermatogenesis of the Characeæ.—**E. Miège**: Strains with polycarpous flowers in a hybrid of *Triticum vulgare*.—**P. Regnier, L. Lespes**, and **C. Rungs**: The habitat of *Schistocerca gregaria* and the succession of generations in this species.—**A. M. Monnier**: A piezo-electric myograph. Its application to the analysis of the isometric jerk of muscles.—**Jules Amar**: The importance and the signification of the vital capacity.—**Mlle. E. Lebreton**, and **F. Mocoroa**: The number and nature of the proteolytic ferments of the pancreatic juice. The author concludes from the experiments described that the pancreatic juice as secreted contains, besides prokinase, only the tryptic ferments inactive proteinase and directly active carboxyl-peptidase. The ereptic ferments found in the glycerol extracts of pancreas are endocellular and do not normally pass into the juice.—**J. Cayrol** and **L. Genevois**: The specific inhibition of the alcoholic fermentation of yeast cells without arrest of the respiration, of the Pasteur-Meyerhof reaction, or of growth. A repetition of Lundsgaard's experiment, with the substitution of monobromacetic acid for iodacetic acid, the former being more active and less toxic. Bromacetic acid in the proportion of 14 mgm. per litre completely inhibits fermentation without interfering with respiration, growth, or the Pasteur-Meyerhof reaction.—**Ch. Dhéré**: The fluorescence spectrum of protochlorophyll.—**Mlle. D. Van Stolk, J. Guilbert, H. Penau**, and **H. Simonnet**: Pure carotene and vitamin A. Full details of the methods of extraction and purification of carotene are given. It is concluded that very pure carotene is capable of maintaining weight equilibrium in the rat and of preventing phenomena of avitaminosis from developing in that animal.—**Cl. Fromageot**: The origin of the energy put at the disposal of micro-organisms in the course of the fermentation of the hexoses.—**Denier la Tour du Pin**: The elective fixation of medicinal ions by the electromagnet. The electromagnet can be used to direct the ions to spots accessible with difficulty; clinical results proving the efficacy of the method are given.—**Georges Blanc** and **J. Caminopétros**: The virus of exanthematic fever obtained from the blood of patients or from the organism of the tic is filtrable.—**Fréd Vlès, Mlle. Marguerite Prager**, and **Nissen Bernstein**: The relations between the isoelectric points of human serum and its alexic power.

CAPE TOWN.

Royal Society of South Africa, May 20.—E. L. Halliday: Correlations between the field changes due to lightning and the appearance of the flashes. A preliminary note upon certain results obtained in investigation of the polarity of thunderstorms in the Transvaal. Photographic records of the field changes due to lightning discharges have been combined with visual and photographic observations of the flashes. Of 273 flashes between the base of the cloud and the ground, 257 gave positive field changes and 16 gave negative field changes. Of 173 positive field changes at distances greater than 7 km., 159 were due to flashes to ground. Of 164 discharges within the cloud at distances greater than 7 km., 150 gave negative changes of field.—**J. Schonland and C. A. Coppens**: Point discharge measurements below thunderstorms. The arrangement used by the authors in Johannesburg and Graaff-Reinet utilises a suitably insulated point and a portable galvanometer. Its simplicity lends itself to the collection of statistical data on the sign and order of magnitude of the fields and field-changes. The arrangement leaves the observer fairly free to note the meteorological features and the distance of the storm.—**M. Rindl**: The alkaloids of the bark of *Strychnos henningsii*. Two alkaloids have been isolated, a crystalline and an amorphous one. The present paper deals with the methods adopted to isolate the amorphous alkaloid and the endeavours to obtain the base itself, or derivatives of it, in a crystalline form.

SYDNEY.

Royal Society of New South Wales, May 6.—O. U. Vonwiller (presidential address): A generation of electron theory. A review of developments in atomic and light theory since the 'isolation' of the electron, with special reference to the accompanying changes in the philosophic outlook of the physicist from the deterministic view general at the end of the nineteenth century to the uncertainty and probability principles of to-day. It is emphasised that the wave theory of light cannot be regarded as more than a convenient hypothesis in terms of which certain phenomena can be reconciled. Light waves may be considered as a mathematical device which can be used to express the probability of the presence of photons just as de Broglie waves can be used with electrons. The evidence for the objective reality of the waves is no greater in one case than in the other.

Official Publications Received.

BRITISH.

City of Leicester: Museum and Art Gallery. Twenty-seventh Report to the City Council, 1st April 1930 to 31st March 1931. Pp. 32. (Leicester.)

Sanatoria. List of Sanatoria and other Residential Institutions approved by the Minister of Health for the Treatment of Persons suffering from Tuberculosis and resident in England and Wales, with the names of the Administrative Counties and County Boroughs in which the Institutions are situate. List 10(d). Pp. 24. (London: H.M. Stationery Office.) 4*d*. net.

Imperial Bureau of Plant Genetics: Herbage Plants. Herbage Extracts, 1931. Vol. 1, No. 1, June. Pp. 39. 1*s*. 6*d*. Bulletin No. 3: The Breeding of Herbage Plants; Technique adopted at the Welsh Plant Breeding Station. Pp. 77+3 plates. 3*s*. (Aberystwyth.)

Empire Survey Review. Vol. 1, No. 1, July. Pp. 48+xviii. (London: The Crown Agents for the Colonies.) 3*s*.

City of Leicester Municipal Libraries. Fifty-second Report to the City Council, 1st April 1930 to 31st March 1931. Pp. 20. (Leicester.)

The Proceedings of the Physical Society. Vol. 43, Part 4, No. 239, July 1. Pp. viii+371-460. (London.) 7*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1375 (E. 47—G. 36, 39 and a): Possible Cause of Aircraft Fires on Crash. By W. G. Glendinning; with an Appendix by Staff of the Engine Department. Pp. 19+6 plates. 1*s*. net. No. 1255 (Ae. 404): The Flutter of Monoplanes, Biplanes and Tail Units (A Sequel to R. and M. 1155). By R. A. Frazer and Dr. W. J. Duncan. Pp. viii+179+12 plates. 7*s*. 6*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Royal Society of Edinburgh, Session 1930–1931. Vol. 51, Part 2, No. 14: Male Haploidy and Female Diploidy in *Sirex cyaneus* F. (Hymen.). By Prof. A. D. Peacock and Dr. R. A. R. Gresson. Pp. 97-103+1 plate. 1*s*. Vol. 51, Part 2, No. 15: Some New Facts about the Structure of the Cuticles in the Russian Paper-Coal and their Bearing on the Systematic Position of some Fossil Lycopodiales. By Jessie A. R. Wilson. With a Note on The Absence of Eliguate Heterosporous Lycopodiales in the Fossil-Record, by Dr. John Walton. Pp. 104-115+1 plate. 1*s*. 3*d*. Vol. 51, Part 2, No. 16: Fourier Integrals. By T. M. MacRobert. Pp. 116-126. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20, N.S., Nos. 1-7: A Modified Form of Radon Capillary Apparatus, by Dr. H. H. Poole; The Exudation of Water from the Leaf-tips of *Colocasia antiquorum*, Schott., by Prof. Henry H. Dixon; The Application of Gamma Radiation to Deep-seated Tumours, II., by Dr. J. Joly; Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 4: Changes in the Colour Composition of Daylight in the Open and in Shaded Situations, by Dr. W. R. G. Atkins and Dr. H. H. Poole; Observations on the Photo-electric Measurement of the Radiation from Mercury Vapour Lamps and from the Sun, and on the Effects of such Radiation upon the Skin, by Dr. W. R. G. Atkins; Some Experiments on the Accuracy obtainable with Gas-filled Photo-electric Cells, by Dr. W. R. G. Atkins; A Method of distinguishing certain Strains of New Zealand Perennial Ryegrass (*Lolium perenne*, L.) by examination of Seedlings under Screened Ultra-violet Light, by P. A. Linehan and S. P. Mercer. Pp. 83+2 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 7*s*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 415, July. Pp. 805-932+xxvi. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1930. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iv+92+2 plates. (London: H.M. Stationery Office.) 2*s*. net.

British Empire Cancer Campaign. Eighth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 20.7.31. Edited by J. P. Lockhart-Mummery. Pp. 202. (London.)

FOREIGN.

Bulletin of the National Research Council. No. 80: Physics of the Earth. 4: The Age of the Earth. Pp. v+487. (Washington, D.C.: National Academy of Sciences.) 4.50 dollars.

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 8, No. 4, March. Pp. ii+239-359+29-38. (Tokyo: National Research Council of Japan.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 9, Part 2, June. Pp. 115-223. (Tokyo: Iwanami Shoten.) 1.08 yen.

Classified List of Smithsonian Publications available for Distribution, May 22, 1931. Compiled by Helen Munroe. (Publication 3119.) Pp. vi+30. (Washington, D.C.: Smithsonian Institution.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 29, Part 4: The Primary Survey of the Vegetation of the Middle Kuriles. By Misao Tatewaki. Pp. 127-190 + 10 plates. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the Utsunomiya Agricultural College. No. 1, April. Pp. 60. (Utsunomiya.)

Publications de l'Observatoire de Genève. Rapport sur les concours de réglage de chronomètres de l'année 1930. Pp. 30. (Genève.)

Proceedings of the Imperial Academy. Vol. 7, No. 5, May. Pp. xi-xvi+179-210. (Tokyo.)

The Structure and Procedure of Cadastral Survey in Palestine. By Major C. H. Ley. Pp. ii+37+8 plates. (Jerusalem: Printing and Stationery Office.) 150 mils.

New York Zoological Society. Report of the Director of the Aquarium. Pp. 27. (New York City.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 12, Supplement: Orthoptera Celebica Sarasiniana. 1: Saltatoria. Von L. Chopard, H. H. Karny und C. Willemse. Pp. 273. (Buitenzorg: Archipel Drukkerij.)

Proceedings of the American Academy of Arts and Sciences. Vol. 66, No. 8: Researches on the Rotation of Permalloy and Soft Iron by Magnetization and the Nature of the Elementary Magnet. By S. J. Barnett. Pp. 273-348. 1.20 dollars. Vol. 66, No. 9: Note on the Kelvin Scale Temperature of Freezing Water. By Frederick G. Keyes. Pp. 349-355. 35 cents. (Boston, Mass.)

National Research Council. Transactions of the American Geophysical Union, Twelfth Annual Meeting, April 30 and May 1, 1931, Washington, D.C. Pp. 229. (Washington, D.C.: National Academy of Sciences.)

Occasional Papers of the California Academy of Sciences. 18: The Avifauna of the Galapagos Islands. By Harry S. Swarth. Pp. 299. (San Francisco.) 3 dollars.

Palæontologia Sinica. Series D, Vol. 7, Fascicle 2: On an Adolescent Skull of *Sinanthropus pekinensis* in Comparison with an Adult Skull of the same Species and with other Hominid Skulls, Recent and Fossil. By Dr. Davidson Black. Pp. iv+144+16 plates. (Peiping: Geological Survey of China.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 8, No. 1, June. Pp. 64. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 6, No. 2. Pp. 163-346+plates 4-11. (Tokyo and Sendai: Maruzen Co., Ltd.)

Proceedings of the United States National Museum. Vol. 79, Art. 3: A New Species of Nematode Worm from the Sage Grouse. By Everett E. Wehr. (No. 2869.) Pp. 3. Vol. 79, Art. 5: Description of a New Genus and Species of Nematode Worm occurring in the Northwestern Belted Kingfisher, with a Key to the Genera of the Subfamily Acuariinae. By Everett E. Wehr. (No. 2871.) Pp. 4. (Washington, D.C.: Government Printing Office.)