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British Engineers Abroad and their Prospects

IN the past, an important source of British influence and prestige has been the large number of British engineers occupying responsible positions in all parts of the world. One serious result of the many changes in world conditions since the Great War is that the position of the British engineer abroad is no longer what it was. The development of technical education in the Dominions and in India now enables these countries to dispense almost entirely with engineers from Great Britain to undertake ordinary engineering work, and from similar and other causes, including nationalistic pride, the openings in the United States, South America, Egypt and other States have been very greatly restricted. Young Argentine engineers, educated in Europe, now occupy responsible positions in their own country, which is developing very rapidly on the industrial side. In the Argentine, also, no engineer is allowed to practise on his own account unless he has graduated in, or has had his foreign qualifications revalidated by, an Argentine university : for this a very high fee is charged.

The national importance of this subject, and particularly its direct relationship to the lives and prospects of the young engineer, using the word in the widest possible sense to include technically trained men of all kinds, has caused the Old Centralians to discuss it in general meeting under the chairmanship of Sir Alfred Chatterton, who has himself had a long and distinguished career in India. The Old Centralians are the Old Students' Association of what is now the City and Guilds Engineering College, London ; they include many of the older generation in their ranks who are well qualified to give reliable evidence on the problem. The "Central" has now sent forth young engineers for more than fifty years : the first small batch included Sir Alfred Chatterton and Herbert A. Humphrey. At times more than half the students went overseas on graduation ; to-day very few are able to find work abroad.

There are still openings abroad for men of special experience who are required for specific work, but such normally involve only short-time engagements ; even in these there is increasing competition from American and Continental engineers. It is urged that in the future only first-class men would be wanted abroad and then for comparatively short periods ; the country which has the best engineering representation, whether on the professional or commercial side, will in the long run obtain the most foreign work.

Trade is said to follow the flag. The engineer carries the flag or even marches ahead of it ; he tends to buy the large quantity of material required for his projects in his native country. Hence it will be appreciated that his replacement will react adversely upon our industries.

The average Englishman to-day is strangely reluctant to go abroad ; the comforts of city life at home appeal more than the idea of roughing it. There is no particular indication that the engineering schools and technical institutes are turning out more men than the industrial life of Great Britain can absorb ; indeed, at the moment when the nation is re-arming and its workshops are being largely rebuilt and reorganized, there is more than enough work. Another difficulty is the apparent prejudice against men who have returned from abroad, who often find it difficult to make a fresh start on their return. The discussion made clear that for appointments abroad there is a scarcity of men for the better positions—of

all-round men possessing all the qualities which are necessary for success in the Colonies.

The immediate problem to be solved is how to prevent a period of overseas service, causing as it does a serious break in the home career, from injuring the future prospects of a technical man. Obviously no general solution is possible : the first practicable step suggested by the Old Centralians is to form an Overseas Engineers Association, which would enjoy the active support of all home professional bodies representative of engineers and engineering colleges as well as of old students' associations, consulting engineers, contracting firms and large engineering and industrial firms. Such an organization would keep a record of engineers qualified to carry out work abroad. It would constitute a source from which contributing organizations would draw engineering staff when need arose and make it easier for the employers to obtain fully trained and qualified men.

The problem is to some extent associated with the training of the engineer, and the time may be opportune to re-examine the engineering courses in relation to modern requirements. The young American engineer, for example, is more highly favoured on outdoor work by overseas employers ; it may be that his training, though less theoretical, none the less fits him better for his work. Mining engineering is known to have this aspect of its teaching under consideration.

It is widely held that the present three-year undergraduate course in engineering in British universities and technical colleges should be extended to four years, not so much with a more extensive curriculum, but designed rather that the students should be given more time to think over their work and to read for themselves.

Looking at the question broadly, it would appear to have two aspects : one is that of giving Englishmen a chance to go abroad without injuring their prospects on their return, which is largely a question of organization and is possible of solution on lines such as the Old Centralians visualize. The more important aspect, however, is the technical equipment of the Englishman so as to enable him to hold his own in a competitive nationalistic world. Besides personality and character and professional knowledge, he must have ideas and originality. These can be trained out of a student more easily than developed in him.

The Trend of Population in Great Britain

THE debate on this subject which took place in the House of Commons on February 10 is one of the many signs of the increasing interest which is being felt in Great Britain in population questions. Mr. J. R. H. Cartland, who moved the resolution, expressed the view, which was accepted by the House, that "the tendency of the population to decline may well constitute a danger to the maintenance of the British Empire and to the economic well-being of the nation" ; and the Government was requested to institute an inquiry into the problem. No new facts were brought forward during the debate, which proceeded on what may be called orthodox lines. Attention was directed to the gradual diminution of the birth-rate since 1875 ; to the resulting fall in the net reproduction rate ; and to the ageing of our population. The question of birth-control was touched upon, and also the present general tendency of married couples to have small families. Mr. Cartland mentioned the existence of the unofficial Population Investigation Committee, which has been formed at the instance of the Eugenics Society.

Mr. Cartland quoted the important pronouncement of the Chancellor of the Exchequer when he introduced the budget on April 15, 1935 : "I must say that I look upon the continued diminution of the birth-rate in this country with considerable apprehension. At the present time it may seem that we have here a larger population than we are able to support in England. . . . But I have a feeling that the time may not be far distant . . . when the countries of the British Empire will be crying out for more citizens of the right breed and when we in this country shall not be able to supply the demand."

Mr. D. Sandys, who seconded the motion, directed attention to the rapid increase in the populations of Russia and Japan. He recalled the estimate of Dr. Enid Charles to the effect that, in sixty years' time, 64 per cent of the women in Great Britain may be past the child-bearing age. He indicated the possibility that, for want of British

emigrants, the Dominions might eventually "be forced to seek emigrants from Asiatic and Eastern European countries". He is of opinion that a declining and ageing population is particularly vulnerable to attack.

These and other contributions to the debate are, no doubt, ultimately based upon the important calculations of Dr. Kuczynski, who has shown how to compute the net reproduction rate of a population by a consideration of the number of future mothers that, say, a thousand mothers will give birth to. To use the words of Prof. A. M. Carr-Saunders, in his book "World Population" (1936), "This simple and beautiful method which we owe to Mr. Kuczynski gives precisely what we need. He has applied it so far as the data are available. But in order to calculate the net reproduction rate we require data concerning specific fertility as well as specific mortality. . . . They are not available for England and Wales because the age of the mother is not recorded on the birth certificate." Here, then, is a simple step towards the calculation of accurate rates, which the Government can take at once, namely, to direct that, in future, the age of the mother shall be entered on the birth certificate.

One or two of those who took part in the debate stressed the desirability of paying attention to the quality of our population.

With regard to the unofficial Population Investigation Committee, alluded to above, this Committee, of which the chairman is Prof. Carr-Saunders, has been formed to examine the factors influencing contemporary trends of population in England and Wales, with special reference to the fall of the birth-rate. It is common ground that, unless a change—at present unforeseen—occurs in social conditions, it is probable that, after some fifteen years or so, the population of Great Britain will begin to decline somewhat rapidly. The objects of the Committee are to ascertain what are the causes of this state of things ; to determine, so far as possible, the social effects of such a rapid decline ; and to see how a catastrophic decline can be avoided. It has been stated on behalf of the Committee that it does not at present take part in propaganda designed to modify existing population trends.

It is to be noted that Mr. R. S. Hudson, speaking for the Government, said : "We do not propose to set an enquiry on foot, because the subject is continuously under enquiry in my Department [the Ministry of Health]. We shall welcome any assistance, but we think it is essentially a matter for the Government and not for outside societies." It may be presumed that the reports of the Population Investigation Committee will be studied and made use of by Mr. Hudson's department.

Mr. Hudson did not agree with those who hold extreme views about the population position. He said that statisticians are not infallible, and that they are not infrequently wrong in their forecasts. They are, of course, limited by the information available and they are obliged to accept existing data. They have not, alas ! the gift of prophecy. Our social structure is of great intricacy, and the fall in the birth-rate may be due to many causes. One such cause may, perhaps, be a perfectly wholesome revulsion from the largely unsatisfactory conditions of the huge Victorian families of a generation or two ago. Few of those who have had the personal experience of membership of a very large family would desire their children to go through the same experience. The argument is not all on one side. There are some who think that a decline in our numbers of a few millions, if the decline could then be arrested, might not be altogether such a bad thing. From a defence point of view there would be less food to import if the country is beleaguered ; we might strike a better balance between our consumption and our home production of food, if there were fewer of us ; we might restore some of the lost amenities of our countryside ; and the better spacing of the children might improve their quality.

It is not impossible that, as a result of the relief afforded by a reduction of our numbers, the population might tend to increase again. In the future—thirty-three years from now—if our numbers in Great Britain were to have come down by some five or six millions, from their present figure of 45·5 millions, as has been predicted, that would bring us to about the same numbers that we had in 1906. Some students of the problem would not object to such a diminution, provided always, as the lawyers say, that the diminution did not continue indefinitely, and that a stationary condition could shortly be reached. But there is no certainty about the matter, and at the best we can only make reasoned guesses. So we may hope that the Government, the Population Investigation Committee and other bodies concerned, may continue their useful labours, moved by a single desire to predict with reasonable probability the situations which may arise in the future.

Recent Progress in Chemistry

Inorganic Chemistry:
a Survey of Modern Developments. By Sir Gilbert T. Morgan and Francis Hereward Burstall. Pp. ix+462. (Cambridge: W. Heffer and Sons, Ltd., 1936.) 15*s*. net.

THIS book is not a treatise on inorganic chemistry, but appears to have developed out of three lectures delivered by Sir Gilbert Morgan in 1933 to the Institute of Chemistry, in which a survey of inorganic chemistry was attempted in the light of the remarkable discoveries of the last few years. For the startling revelation in the year 1933 of the isotope of hydrogen, and of the existence in ordinary water of an undreamt-of heavy constituent—a new variety of water in fact—can only be compared to the surprising discovery in 1894 of a new inert gas, argon, in atmospheric air, and in very appreciable quantity. That the commonest and most extensively existent liquid—forming the great oceans themselves—and the very atmosphere which we breathe, should possess concealed within them hitherto unknown constituents in such appreciable quantities, were facts indeed to give a new outlook to chemistry; and not merely to inorganic chemistry, but as regards the isotope of hydrogen, also to organic chemistry, considering that hydrogen is so important a constituent of countless carbon compounds. Indeed, at first sight an appalling vista of new hydrocarbon compounds and derivatives arises before us. When to all this we add the astonishing progress made by physicists in our knowledge of the structure of the chemical atoms, and especially of the atomic nucleus, and also in the artificial disintegration of the chemical elements—a whole series of new fugitive elements possessing induced radioactivity being called forth—there can be no wonder that it becomes necessary to take stock of the position.

The introductory chapter affords a brief survey of the development of our information concerning the ninety-two chemical elements, their classification, atomic weights and atomic sequence numbers; it marks the milestones on the fascinating road which inevitably led to the recognition that the atoms themselves have structure. The most notable referred to are the discovery by Sir William Crookes in 1879 of the cathode rays, electrons; by Moseley in 1913 of the meaning of the atomic sequence number of the element, as defining the positive charge on the central nucleus, and the number of negative planetary electrons around it, affording a wonderful explanation of the long mysterious periodic classification of the elements; and the discovery by Sir J. Thomson of positive rays, and of isotopes by Soddy in 1913, leading to the development by Aston in 1919 of his positive-ray mass-spectrograph, by which an immense number of isotopes (elements corresponding to the same atomic number but having atomic weights differing by one or more whole numbers) have been identified, one for almost every whole number up to the atomic weight of bismuth, 209. It then passes on to discuss the electronic conception of valency, the distinction to be drawn between electrovalency (as in sodium chloride), and co-valency (as in methane) involving the sharing of electrons, and to a wider application of the co-ordination theory. The second chapter deals with the key elements, the inert gases, and hydrogen. Chapter iii then proceeds to relate the facts concerning the isotope of hydrogen and heavy water, deuterium oxide, D_2O, of the properties of which latter liquid an excellent account is given, including its physiological effects as far as they have yet been examined. The chapter concludes with a description of other deuterium compounds, such as the deutero-ammonias (deuteramines), deuterium halides, and deutero-methane CD_4, and heavy benzene C_6D_6 and naphthalene.

In a succession of further chapters, the periodic groups of closely related elements are dealt with in turn, and this portion of the book is full of structural formulæ, largely in connexion with the theory of co-ordination. At the end of the discussion of the eighth (iron-platinum) group, attention is directed to the necessity of remembering "that the cosmic pendulum traces out the evolution of chemical elements in a continuous helical curve which for convenience may be regarded as being described around an octagonal prism on each face of which is tabulated a vertical series of elements arranged in two alternating natural families". Referring to the noble metals and the inert (noble) gases, the authors express their opinion as hard-working chemists that "the badge of nobility seems to be idleness and detachment from ordinary mundane matters. To this ideal the inert gases—the key elements—thoroughly conform in all readily realisable circumstances. They are the *rois fainéants* of chemical elements".

A very interesting chapter (xii) follows, on the transmutation of the elements, natural and artificial, and an account is given of (1) spontaneous

disintegration, exemplified by uranium and radium, (2) artificial disintegration by means of high-speed particles such as helium nuclei ($_2^4$He), protons ($_1^1$H), deuterons ($_1^2$D), or neutrons (^1n), and (3) induced radioactivity by bombardment with helium nuclei (α-particles), neutrons, deuterons, or γ-rays. The light particles concerned in all these transmutations or disintegrations are considered as the "primordial stuff common to all elements". The electron, the particle of the cathode rays and the negatively electrified and planetary non-nuclear part of any atom, is considered as truly particulate, but in view of the diffraction of electrons they are also considered to possess some wave-like attributes. The positron, the positively electrified electron discovered by Anderson in 1932 as arising from the action of cosmic rays on terrestrial matter, and since also obtained by Curie and Joliot by bombardment of light elements by helium nuclei (α-particles) or neutrons, has the same ratio of electrical charge to the mass as the electron, but the sign of the charge is opposite. The positron may, indeed, be also obtained by the action of γ-rays on aluminium, copper, silver, platinum, lead, bismuth and uranium. It is not surprising that the positron should have eluded discovery so long, for its length of life is only the fraction of a second.

The neutron is a particle, first clearly recognized in 1932 by Chadwick, without charge and having a mass 1·0085 nearly identical with that of the proton, and its discovery has led to a most important change of view as to the nature of the nucleus. For the fundamental units contained in it are now seen to be protons and neutrons instead of protons and electrons. Indeed, protons and neutrons may be regarded as the same fundamental particle in two different quantum states; the neutron becomes a proton by liberation of an electron, and a proton becomes a neutron by giving rise to a positron. The stability of the nucleus appears to be dependent on the relative numbers of neutrons and protons which it contains. The proton is now fully substantiated as the hydrogen ion ($_1^1$H) of mass 1·0081 (^{16}O = 16), and carries a positive charge. It may, in fact, be regarded from the above as a neutron plus a positron. Protons are readily produced by passing an electric discharge through hydrogen, while neutrons are most easily obtained by treating beryllium with either γ-rays from radium or with X-rays of $1{\cdot}5 \times 10^6$ volts.

The helium nucleus (α-particle) is now accepted as possessing a mass of 4·002 (^{16}O = 16), and carrying a positive charge of two units, and is the only massive particle yielded by the spontaneously disintegrating radioactive elements. Although complex, containing two neutrons and two protons, it is a fundamental particle which has never been disintegrated, being uniquely stable. The nuclei of all elements of greater atomic weight than helium itself are largely made up of helium nuclei. The neutrino of which we have lately heard is probably only a mathematical conception.

The above facts are clearly brought out in the book, and it is a comfort to see them so, for of late it has not been at all easy to follow the rapid sequence of new discoveries in this sphere. It has to be remembered, however, that besides the uranium, thorium, and actinium series of spontaneously radioactive elements, potassium, rubidium and samarium have also been observed to exhibit the phenomenon of radioactivity. In the case of potassium it is probably the isotope ^{41}K which shows it, the isotope which is only present to the extent of seven per cent in the metal. But since 1934 we have been confronted with the most astonishing phenomenon of all, that of induced radioactivity, by the discovery by Curie and Joliot of the effect of bombarding boron and aluminium with α-particles (helium nuclei), or graphite with accelerated protons and deuterons, the former operation producing radioactive nitrogen $_7^{13}$N and neutrons from boron, and radioactive phosphorus $_{15}^{30}$P and neutrons from aluminium; the latter operation also gives the same active nitrogen, which disintegrates with expulsion of a positron, and with deuterons either the same result or the formation of protons and inactive carbon. Sometimes with boron an active form of carbon resulted, $_6^{11}$C. More surprising still, Fermi and his colleagues in 1934 and 1935 have produced more than forty new radioactive elements having atomic numbers from seven to ninety-two, by bombarding inactive elements with neutrons.

The neutron proves to be particularly powerful in penetrating the nuclei of many elements, giving rise to the new radioactive elements. Water and common salt can now be made to furnish respectively deuterons and radioactive sodium, this latter possessing properties very like those of radium, and it may be of use in medical work. The life-period of these new elements is very short, varying usually from a few seconds to less than one hour, and exceptionally, in the maximum, three days. For example, active carbon, $_6^{11}$C, lasts for forty minutes, while radio oxygen $_8^{15}$O lasts four minutes and radioaluminium, ^{28}Al, five minutes. It must be remembered, however, that so long ago as 1919 Lord Rutherford had effected the artificial transmutation of nitrogen, by exposing it to α-particles emitted by radium-C, oxygen ($_8^{17}$O) and high-velocity protons being produced; but only one α-particle in a million was actually effective.

A further chapter (xiii), on co-ordination compounds in Nature, the arts and industries, shows how the co-ordination theory explains many cases of simulated isomorphism, such as those pointed out by the late T. V. Barker. The cases of the silicates, classified by W. L. Bragg according to their structure as determined by X-rays, are also referred to as typical examples of the application of the theory. Then comes a chapter on the corrosion of metals, in the course of which the estimate by Sir Robert Hadfield is referred to, that the world's annual loss by the corrosion of iron, steel and other ferrous metals amounts to no less than seven hundred million pounds sterling. This is followed by a chapter on alloys, and the light which X-ray analysis has recently thrown upon them. Successive chapters then deal with (*a*) carbides ; (*b*) the metallic carbonyls, and the value of Raman spectra in deciding the character of the linkage between carbon and oxygen, and in thus revealing the cause of the remarkable stability of these compounds ; and (*c*) the nitrosyl compounds ; and finally (*d*) the organic derivatives of metals and metalloids.

In reviewing a book such as this, for which one can have only the highest admiration and gratitude for its production, only one slight criticism may perhaps be permitted. The great emphasis laid on the theory of co-ordination appears to have led to the overlooking of the wonderful way in which the progressive structure of the atoms of related elements of the same family group is reflected in the similarly progressive variation in the properties of their isomorphous compounds ; in their crystalline characters (including crystal-angles), the dimensions of their similar unit structural-cells, their optical, thermal, electrical, and elastic constants. It is indeed most striking how beautifully the addition of each shell of electrons, as we pass from one member of the family of elements to the next, is seen to be revealed and marked by the advance of every natural property and physical constant. If, in addition to the reference to the alums on page 93—which do not exhibit the variation in symmetry constants, as they crystallize in the cubic system the angles of which are fixed and invariable—the cases had been considered of the rhombic sulphates, selenates, chromates, perchlorates, permanganates, and especially the monoclinic double salts with $6H_2O$ now generally known as the Tutton salts, a series of seventy-seven salts all of which have been investigated in detail, it would have been clear that in these variations, following exactly the order of the atomic complexity of the interchangeable elements, we have one of the most wonderful and complete confirmations and exemplifications of the effect of atomic structure on chemical constitution and physical character possible to imagine.

The book is excellently printed, in good sized type very pleasant to the eye, and does great credit to the publishers. A. E. H. TUTTON.

The New Hebrideans

Savage Civilisation

By Tom Harrisson. Pp. 461 +32 plates. (London : Victor Gollancz, Ltd., 1937.) 16*s*. net.

MR. TOM HARRISSON was a member of the Oxford University expedition to the New Hebrides in 1933. When the expedition left the islands he elected to remain behind, and spent a year living as a native among the natives, was for a time an official, and ended by taking part in a cinematograph film.

Whether of set purpose or not, Mr. Harrisson's narrative is arranged with consummate skill. An account of New Hebridean culture, which sets out the principal features of the economic, social and religious complex, is followed by a survey of European contacts with the islanders from the time they were first discovered by de Quiros in the early years of the seventeenth century down to and including the present joint administration of French and British under the Condominium. The author has expended considerable pains on piecing together the narrative of missionary work and the obscure record of 'blackbirders' and sandalwood traders. His critical views on the Condominium are at first hand.

The reputation of the New Hedrideans for ferocity and treachery is based on the evidence of traders and missionaries, and is a long tale of murder and aggression. The contrast between native and Europeans, even as set out here, made this almost inevitable. The narrowness of the missionary outlook, and the brutalities, cruelties and injustice inflicted on the natives by traders and labour-recruiting ships, gave unlimited provocation. At the same time, narrow as the missionaries were, they are scarcely to be blamed if their ideas in the early days were not in advance

of those of their contemporaries. Mr. Harrisson's vivid and racy story of his personal experiences among unadministered natives on Malekula and Espiritu Santo serves as a foil, and redresses the balance as against the traditional view.

A tribute is paid to the medical work of present-day missions. The tendency of the population at the present time to increase is attributed in large measure to improvement in hygiene and medical attention, although the latter is still inadequate. The view of the late Dr. W. H. R. Rivers that the decline in population among the islanders of the Pacific was psychological in origin, and due to a *tædium vitæ* caused by the break-up of native custom, is regarded as disproved, at least so far as concerns the New Hebrides.

As a picture of island life seen in intimate conditions, Mr. Harrisson's book is a notable, as well as an entertaining, addition to the travel literature of the Pacific.

A New Higher Algebra

Higher Algebra

By S. Barnard and J. M. Child. Pp. xiv+585. (London: Macmillan and Co., Ltd., 1936.) 20*s*.

THIS new "Higher Algebra" will be examined with great interest by all teachers and serious students of mathematics. A book of this type is certainly needed at the present time, and the one before us should go far towards providing that stimulus which the teaching of algebra urgently requires.

The book is rather an outsize, containing 585 pages, and at a first glance the reader is inclined to wonder why. For, in the main, the scope of the book is similar in extent to that of the older higher algebra texts; yet more than the usual amount of previous knowledge of mathematics is assumed: a "knowledge of the progressions and permutations and combinations". The authors might have added that the binomial theorem for a positive integral power is also assumed.

A closer examination shows that the various topics are treated very fully indeed, and that there are, in addition, several chapters which do not appear in the usual algebra text. For example, the early part of Chapter v, which deals with complex numbers, leads to the statement and development of De Moivre's theorem, the real and complex factors of $x^n \pm 1$ and vectors. Similarly, the discussion of continuity leads naturally to the derivative of a function and to the notation and methods of the calculus.

It is apparent that the authors have attached considerable importance to placing the notion of real number on a firm and sound basis; in this connexion, the book compares very favourably with many of its predecessors. On this sure foundation the subject is "developed logically, complete as far as it goes and serving as an introduction to modern analysis". Indeed, the title might well have been "An Introduction to Mathematical Analysis".

The arrangement of the work differs from that adopted in most higher algebra texts in that only as much of a topic is introduced as is immediately necessary for the development of the subject. For example, the theory of equations is not confined to a single chapter—the topic is introduced so early as Chapter vi and is further developed in Chapter xviii; similarly with theory of numbers, polynomials, convergency, continued fractions, etc. In this way there is no suggestion of water-tight compartments. Most of the topics are treated in considerable detail; this is particularly the case in the treatment of the theory of numbers and the theory of equations.

Although a mathematically minded student might work through the book unaided (and so many hints are embodied in the exercises one feels that the authors have not forgotten this class of student) it is not suitable and is not intended for beginners. The Higher School Certificate students mentioned in the preface are students taking the mathematics group—and such students are supposed to be of special mathematical ability.

Both the publishers and the authors are to be congratulated on the finished appearance of the book; the printing is excellent, though some rather small type has been used in the worked examples, and the book has an appearance of solidity which is in keeping with its contents. There are many good sets of examples. Although the book is rather large, one feels that a few historical notes would have made for even more completeness than there is already. No teacher or serious student of mathematics should be without a copy of this excellent book.

Methodik der Hormonsforschung
Von Dr. Christian Bomskov. Band 1 : Schilddrüse, Nebenschilddrüse, Nebennierenrinde, Nebennierenmark, Pankreas. Pp. xxi+716. (Leipzig : Georg Thieme, 1936.) 54 gold marks.

Dr. Christian Bomskov has undertaken the production of a reference work dealing with all the methods used in the investigation of hormones. The first volume contains a general discussion of methods, and special sections dealing with the thyroid, the parathyroids, the suprarenal cortex and medulla and insulin.

It would be impossible for one man to prepare a critical review of so large a field, and those who have specialized will be able to criticize details, but there can be no doubt that Dr. Bomskov has produced a work that will be very useful to those who wish to know the details of the experimental methods in use. Most of the important methods are described in full detail, and references are given to descriptions of other methods.

The general discussion is divided into sections dealing with surgical methods, histological methods, biological methods and chemical methods. These are each discussed in detail. For example, the section on biological methods deals, among other things, with the obtaining of samples of blood, stomach tubes, injections, weighing, measuring the body temperature, the registration of respiration and blood pressure, isolated hearts, perfusion and isolated plain muscle.

Each of the special sections is subdivided in the same way and the general arrangement is so good that it is easy to find any particular piece of information without reference to the index. The surgical part of each section contains full instructions, illustrated by diagrams and photographs, for removing each gland from all the commoner laboratory animals. The histological part discusses special methods appropriate to each gland and gives photomicrographs of the appearance of the glands. The biological part discusses all the effects which the different hormones produce, and methods of assay. The chemical part gives methods of isolation, chemical assay and, where possible, methods of synthesis.

This book meets a definite need and can be warmly recommended as a book of reference. It gives a reasonably complete list of the methods available, including the bad methods with the good methods, without much attempt to discriminate between them.

Lehrbuch der Mineralogie
Von Prof. Walter Schmidt und Dr. E. Baier. Pp. vi+320. (Berlin : Gebrüder Borntraegar, 1935.) 14 gold marks.

The two authors of this text-book are in charge of the tuition in mineralogy at the Berlin Technische Hochschule. Mineralogy is a science which impinges upon several other sciences, especially geology, physics and chemistry and the number of students who have to acquire at least a general acquaintance with it tends steadily to grow. Prof. W. Schmidt is responsible for the text in general, while the special sections in smaller type have been contributed by Dr. E. Baier, his assistant.

The book is in reality in two parts, although not definitely so divided. The first part, which forms a general introduction to the subject, is occupied with such parts of crystallography, optics, chemistry and geology as apply to mineralogy. The treatment is confined to general principles ; nothing, for example, is said about goniometers, refractometers or other apparatus. The part includes interesting chapters upon the classes of crystal symmetry, the X-ray study of crystal structure, geochemistry and paragenesis. In the second part the important characters of the principal mineral species are concisely yet fully described, the arrangement being by elements, sulphides, oxides, silicates, etc., and halogens.

The numerous illustrations greatly add to the value of the book ; thanks to the calendered paper used, they are clearly printed, but, on the other hand, the shiny surface is irksome to the reader. Mention should be made of the excellent figures in colour which are inserted at the end, representing a quartz wedge between crossed nicols and uniaxial and biaxial interference figures. Subject and mineral indexes facilitate reference to the book, and the clarity of the exposition throughout is admirable.

Back in the Stone Age :
the Natives of Central Australia. By Dr. C. Chewings. Pp. xx+161+23 plates. (Sydney and London : Angus and Robertson, Ltd., 1936.) 7*s*. 6*d*.

Dr. Chewings's experience of the blackfellow dates back to 1881, when he took up a grant of land in the MacDonnell Ranges of Central Australia. The tribes with whom he then came into contact were the Aranda (Arunta) and Loritja described in detail by C. Strehlow, a missionary of the Hermannsburg Mission, more than thirty years ago. When Dr. Chewings first met them, they were living literally in the stone age, their only cutting implements being of stone. He describes their daily life, their social organization and magical beliefs and practices as they presented themselves to the squatter, but with certain explanatory additions to make them intelligible to the ordinary reader, which he has gleaned from the work of Strehlow and Spencer and Gillen. His actual experiences as an employer of the blackfellow in the work of the station and in his contacts with them and their *lubras* tell us even more of their characters and capacities than his account of their customs.

Notwithstanding the reserve policy and the care of the Governments for the aborigines, Dr. Chewings thinks the drift towards the centres of civilization is inevitable and the ultimate fate of this people extinction. This opinion, based on long experience and understanding of the blackfellow, cannot be ignored ; but the Federal Government has already carried out some of the measures advocated by the author, and experience elsewhere in analogous conditions among backward peoples suggests that extinction is by no means so inevitable a fate as he thinks it to be.

Old Diseases and New*

By The Right Hon. Lord Horder, K.C.V.O.

IT would be impossible to say that any disease has completely died out, and it would be an unwarrantable assumption to say that any disease is a new disease. All the same, it is certain that a number of diseases, which were formerly rife, not to say decimating in their effects in the past, have become obsolete, and it is almost, though not quite, as certain that other diseases have increased considerably during recent times. It is in the sense of the general nature of the problem which diseases present to-day as contrasted with years ago, that I use the words "new" and "old".

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Diseases of the heart and blood vessels have taken a prominent position in medicine during recent years. To what degree this is due to an increase in their incidence, or to our improved methods of detecting them, or even to more notice being taken of them now that the more obvious 'villains' have quitted the stage—these are difficult questions to answer. But physicians of two, and still more of one generation ago, were very good observers, both by the bedside and in the autopsy room. So that we have their, and our own, experiences to compare, and on this basis there seems no doubt that diseases affecting the organs of circulation are relatively more rife than formerly.

What is called atheroma, or degeneration in the large arteries, is a very ancient disease. Egyptian mummies, embalmed 2,000 years before Christ, show it. Aneurysms, which are saccular dilatations of the big arteries and which were certainly fairly common until fifty years ago, have become comparatively rare. This is because the particular infection which attacks the walls of the vessel is diagnosed much earlier, and is successfully treated, But the more diffuse and less dramatic disease of the arteries which we term arteriosclerosis is very common indeed. This sort of arterial thickening overlaps with other troubles which are partly a result of the loss of elasticity in the vessel wall, and partly compensatory in nature. One of these is arterial hypertension, 'high blood pressure' as it is popularly called. This state of affairs was well known to the physicians of the generations immediately past, who could quite well detect it, even in its early stages, without the help of that instrument of precision by which it may now be exactly measured.

High blood pressure is not a disease in itself; it is an expression of disease; it is one aspect of that 'rock' or disturbance in the equilibrium by which we have defined disease. It may even, at certain epochs of life, be regarded as physiological. In many cases the increased arterial tension follows, or accompanies, increased nerve tension, the latter being of greater importance in the diagnosis than the former. The older physicians regarded high blood pressure as part of a generalized gouty state. It may well be that, with the great decline in gout in its more classical phases, such as an acute inflammation of the big toe, the same morbid processes—chemical, nervous and infective—are expressing themselves nowadays in the direction of these changes in the circulatory apparatus.

Blood pressures that are below the average are also common. These give the medical man quite as much food for thought as do the high pressures, but they have not, so far, engaged the popular imagination, because the results of them are not dramatic. Perhaps they are the modern equivalent of what used to be called 'poor man's gout'.

Then there is another disease of the blood vessels, and a serious one, which some of us consider to be a comparatively modern disease, and this is a tendency for the small arteries which supply blood to the wall of the heart to become blocked. Our technical term for this is 'coronary thrombosis'. Even when we have allowed for the number of these cases which were formerly included in the category of 'angina pectoris', the incidence of the disease is still, many of us believe, higher than it formerly was. Like all diseases of the circulatory apparatus, it is more common in males than in females. The main causative factors are as yet obscure. Tobacco, and especially cigarette smoking, has been suspected, and there would seem to be something in the life of a medical man which makes him specially prone to this affection.

There is also that curious condition termed 'halt-palsy', in which we postulate a spasm of the arteries in the legs with, in most cases, an early degree of thickening of the vessels. The main symptom is so striking that it is scarcely credible that it would not have attracted the attention of the older physicians had it been as frequent in

* From a Friday evening discourse delivered at the Royal Institution on February 26.

the past as it is to-day. The patient is suddenly seized with pain in one or both legs when walking; he halts for a minute or so and the pain ceases; he starts off again and is brought up sharply at about the same distance, stops, and is again relieved.

Nor are our veins exempt from a 'new' disease. Inflammation of a large vein, with the formation of a clot, has been known for a very long time. But it is only during recent years that we have become familiar with a disease in which the inflammation affects a number of the smaller veins, and creeps about from one to another over a period of, it may be, several months. This tendency has given the malady the name 'phlebitis-migrans.

It is very difficult to say to what extent the work of microbes enters into the production of these troubles in our blood vessels. That it *is* a factor in some of them seems highly probable. The one thing that seems certain is that the type of germ concerned is not that which 'lays us out', as the expression goes, by a process of acute and lethal infection.

I want to deal with this last point rather more fully, and in connexion with the last of the modern diseases I will mention in which the organs of the circulation are mainly involved. This disease is what we call 'septic endocarditis'. The valves of the heart become the site of colonization of microbes, causing an inflammation which, at some time or other, produces ulceration. When this process has arrived, particles of tissue carrying masses of the microbe are swept off into the blood stream, and get lodged in the network of small vessels in various organs at the periphery of the circulation. In the great majority of cases these microbes are 'streptococci'. A form of blood poisoning is thus set up, to which the patient unfortunately, and despite all we can do, sooner or later succumbs in a very high percentage of cases.

If the germs concerned in this process are virulent germs, such as those which cause acute blood poisoning, or boils, or pneumonia, the disease is fulminant and of short duration—it may be days only. If, however, the germs are not virulent, or, as we express it, only feebly pathogenic, the disease is insidious, slow, and its duration may extend into two or even three years. There is no doubt that the old type of the disease (if I may speak of diseases in types) was generally of the former kind, whereas the tendency nowadays is towards the latter kind. Indeed, acute cases of septic endocarditis have become comparatively rare, and the chronic cases have become all too common. In the altered character of this one disease, therefore, we see illustrated the change that has taken place in bacterial diseases in general: the acute and virulent sorts have come under control, and are either obsolete or have diminished greatly in incidence; the chronic sorts have increased, and so far, have escaped control.

When we come to examine carefully the actual bacteria that are associated with these chronic infections, or, as Adami conveniently terms them, "sub-infections", we find that they are not to be distinguished by any known characters from the bacteria that are indigenous in our bodies during health. If, however, they pass the barriers of the mucous membrane, and enter the solid tissues of the body, or the blood stream—except perhaps in such minute numbers as can be promptly killed or as promptly eliminated by the kidneys—diseases may arise, generally of this insidious and chronic form. There are several more of such diseases, in addition to septic endocarditis, but I must not stay to speak of them. The general term under which we speak technically of this set of diseases is 'focal sepsis'. It is in connexion with them that many of our patients talk to us nowadays in the language of the bacteriological laboratory—perhaps with the possessive proudly added—as "*my* streptococcus, doctor", or "my bacillus coli".

What the factors are that determine these sub-infections we are as yet unable to say. We speak, rather loosely I am afraid, about 'lowered resistance', but we are quite unable to define this term exactly. Until we know more about the nature of the natural defences of the tissues against bacterial invasion, and perhaps more, too, about possible mutations in the bacteria themselves, this part of the mechanism of sub-infections will remain obscure.

If we turn now to another group of diseases which bulks largely in modern medicine, those associated with what are called the internal secretions of the body, or hormones, it is still more difficult to say if these have increased in frequency, because our knowledge of these substances is comparatively recent, and the study of what we call endocrine imbalance is therefore also recent.

With that natural desire to unload the defects of behaviour upon anything that comes to hand which is outside our control, we like to think our 'glands' are at fault when our temper is not well governed, or when we are moody, or when, in any way, we are anti-social. Allowing fully for this weakness, there still remains a large residue of cases in which we can trace the jostle suffered by the normal equilibrium to disturbances in this part of our economy.

If we include diabetes in this group, on account of its close association with the internal secretion

of the pancreas, we have figures which show a considerable increase in the prevalence of this disease. The number of diabetics in Great Britain in the year 1923–24 was estimated at 29,000. The estimate for 1934–35 was 70,000. In the United States the increase is said to be even greater. Since diabetes is not a disease of old age, these figures are not explained by the increase in the expectation of life which has taken place during the same period.

In the sphere of the nervous system, the position appears to be this: that whilst the incidence of what we term the major psychoses, that is, the forms of mental derangement requiring institutional treatment or special nursing, remain much as they did, there is a large increase in the minor psychoses or psychoneuroses, as they are more properly termed. The condition called anxiety neurosis is very common and neurasthenia still more so—indeed neurasthenia is one of our major problems in medicine to-day, both as regards its causes and its treatment.

The first appearance of that form of inflammation of the brain called encephalitis lethargica is quite uncertain, because in the severe cases of influenza cerebral symptoms have often appeared, causing confusion in diagnosis. But serious outbreaks have occurred in the present generation, as well as many sporadic cases. The number of cases in which the brain symptoms appear, the fever having been overlooked, or being absent altogether, is probably still under-estimated. The same applies to influenza nerve symptoms, though these are, of course, less serious. Acute poliomyelitis, better known by its trivial name, infantile palsy, has close affinities with encephalitis, and as there is authentic evidence that this disease existed long ago in Egypt, it is probable that encephalitis did also.

The claim that there *are* new diseases might well be supported, even though they are more interesting than extensive. By way of illustration, there are diseases which are the direct result of modern treatments. There is what we call serum-sickness, for example, a state of things which often follows a week after the injection of serum derived from the horse, as for diphtheria or tetanus.

There are diseases which follow the use of X-rays and of radium. There are effects which we do not aim at, but cannot sometimes avoid, following the use of a number of drugs, both inorganic and organic. We may do an arthritic patient a great deal of good by injecting him with a preparation of gold, yet the metal may disturb his system in such a definite manner that we do, in effect, set up another disease. We may clear a man's tissues of gout by means of a drug called atophan, and give him disease of the liver. We may assist considerably in the healing of a gastric ulcer by the intensive use of alkalis, and induce a disease called alkalosis. A Scots patient for whom I once ordered bicarbonate of soda was so struck by the relief of his stomach ache that he expressed his fear lest his body would have to pay for a drug which was so "verra powerful". His fear had an element of justification.

By the use of insulin we are able to keep the amount of patient's sugar circulating in a diabetic blood at a proper level. But an overdose may reduce the sugar below the normal threshold and the result is a well-recognized disease.

Then there are new diseases incident upon new occupations. Occupational diseases were well known to the old physicians. Paracelsus described the lung disease of miners at the beginning of the sixteenth century. But T.N.T., and the disease of the liver which may follow from handling it, are entirely modern; and since our forefathers did not make war with poisonous gases, the diseases incident upon their inhalation are peculiar to this more civilized age.

Looking now at the germ diseases over which we still have practically no control, they are probably, nearly all of them, the result of infection of the body by a special type of microbe which we call a virus. Filtrable viruses, they are sometimes termed, because the infecting agent passes through the finest (porcelain) filter available. This infective material has been proved to contain extremely minute particles: the name "elementary bodies" is given to them. We owe the first description of these particles to a Scot named John Brown Buist, who found them in the calf lymph used for small-pox vaccination and also in material removed from small-pox pustules. After the delay that so often follows original observations like these, a number of other workers have studied these Buist bodies, and have confirmed their presence and importance. British bacteriologists have been amongst the foremost in these researches, and in particular, Dr. Mervyn Gordon and Prof. J. C. G. Ledingham.

There is a lot of evidence for regarding virus bodies as being the cause of influenza, encephalitis lethargica (or sleepy sickness), infantile palsy, mumps, measles, and also (some would add) the common cold. What is equally important, there is a growing belief that the mystery of cancer, a disease which equally lacks control in the true sense of the word, may find part of its solution in the discovery of specific virus bodies. That cancer *is* a microbic disease becomes more and more a convincing hypothesis as intensive research into its problems continues. It is not difficult to

visualize these minute virus bodies—each one is from five to ten times smaller than the ordinary micrococci—settling like so much dust, inside the very substance of the cells of an organ, successfully colonizing there (successfully, that is, from their own point of view) and thoroughly disorganizing the cell economy. The life of the cell continues—it is not killed—but it is stimulated (irritated) into that state of chaotic over-growth which is the very essence of cancer. I do not know of any problem connected with cancer as a disease which is not capable of explanation upon the basis of a hypothesis like that. We shall see, if we continue to be patient and painstaking and work with some vision, if this be the truth or not.

It is often held that the incidence of cancer has increased during the past fifty years. This is very difficult to prove. Several possible fallacies come into the argument, especially improved diagnosis, and better methods of registration. Cancer is a disease of the second half of life ; indeed, to a large extent it is a disease of old age. An increase in the number of cases of cancer may therefore be no more than a confirmation of what we know already—that the expectation of life has risen by 15 years during the past two generations. Old age brings not only its own infirmities but also its own diseases. Senility is itself a disease, and it is on the increase. If we go on as we are going, a man giving this lecture in sixty years' time will probably stress senility as being one of the most striking of the 'new' diseases.

It seems to me that certain generalizations emerge from this discussion of 'old' and 'new' diseases. There has certainly been a swing over, as it were, from those frequent and devastating gusts of acute and virulent germ diseases to more insidious and chronic maladies. Life was very precarious in Elizabethan days and in the centuries immediately preceding and following them. We must remember that what we know to-day about those terrible scourges refers only to the big epidemics ; there must have been thousands of what are called 'sporadic' cases, and there were places where some of these pests made themselves endemic. So that, in addition to the big waves of fevers that brought death in great swathes, there was the steady, constant loss of life in these other ways. Sydenham estimated that in his day fevers accounted for 70 per cent of the whole of medical practice. To-day this figure is not more that 10 per cent.

The Elizabethan was very alive to-day and very dead to-morrow. If we exclude influenza, which still seems to possess something elemental in its potentialities—that is, judging by 1918–19, rather than by the mild epidemic we have just experienced—there are no diseases nowadays that spell violence as diseases did in Sydenham's time. Unless we call venturing upon the streets and roads a disease. Or war ; which is, after all, the greatest of all modern diseases, though it is a disease of the mind and not of the body. It has existed since the race began, but its casualties were formerly trivial by comparison with those due to disease. To-day the proportions are reversed. The Great War cost us more than 700,000 lives and 2½ million total casualties. At the beginning of 1920 there were just over one million war pensioners, and even in March of 1936 there were 400,000 permanent pensions being paid. Of these, 40,000 were on account of mental and nervous diseases. Science has reduced enormously the casualties due to the attack of the microbe upon man ; but science has increased in much greater proportion the casualties due to the attack of man upon man.

Then, again, the question arises, what of the integral stuff of our bodies and of our minds ? It looks as though our enemies have become the men of our own house, rather than those who have got entrance from without. Why is this ? Has something gone wrong with the control ? Or, to change the metaphor, are we discharging the battery at too high, and charging it at too low, an amperage ? *Why* are we becoming the preys of our own saprophytes ? *Why* is the tubing of our blood vessels, and why are the working parts of the pump, wearing so badly ? These questions cannot yet be answered, or not in this place !

We are living longer ; that is one of the most striking results of the past fifty years of hard but intelligent work on the part of those who have inspired and administered our public health services. Does someone ask *cui bono ?* Why live longer if we cannot live more healthily and more happily ? For it certainly does look as though, for many of us, our lives become 'thin spun' long before the 'abhorred shears' are due—so why take such pains to defer them ? Is our meticulous care of our shadowy present worth it ? Is it worth suggesting security to ourselves in a gas mask and an (alleged) bomb-proof cellar ? But surely the answer is with us who do the living ? How *long* a man lives depends upon his ancestors and the state of the public hygiene. How *healthily* and how *happily* he lives depends upon himself. Also be it observed that mere absence of disease is not enough. Therefore we welcome an attempt by the State to organize the national physique. Later, but I trust not too late, perhaps we might do something to organize the national mind ; and so get back some of the *zest* for living that we seem to have lost, and the ability to enjoy this immunity from disease that we have accumulated.

The Transition State in Chemical Kinetics

By Prof. M. Polanyi, University of Manchester

THE energy barrier separating the initial and final states of a reaction has ceased to be a fictitious concept since the main principles of chemical inertia were discovered by F. London (1927). For some simple cases, we can now calculate the energy changes occurring during the process of reaction, and follow the paths along which the atoms move. We can, in particular, obtain in many cases a clear picture of the configuration which corresponds to the top of the energy barrier. This configuration is called the *transition state* τ of the reaction.

It is interesting to deduce Arrhenius's equation by thermodynamical considerations relating to the transition state. At chemical equilibrium we see the atomic configuration changing forwards and backwards between the initial and final states of a reaction, and passing on each occasion through the transition state τ. The positions which the atomic system takes up between the initial and final states form a continuous sequence and can, therefore, be defined by one co-ordinate l which is called the 'reaction path'. At equilibrium we have a certain infinitesimal number of reacting systems in the transition state, that is, near the top of the energy barrier. This number (population) can be equated to the concentration product of the reactants, say, $c'.c'' \ldots$ into an infinitesimal equilibrium constant $K_1 dl$.

$$\text{Population } (\tau) = c'.c'' \ldots K_1 dl$$

Since

$$\text{Population} = \text{birth-rate} \times \text{average life},$$

we can calculate the birth-rate by noting that the average life of τ is equal to a thermal velocity v over dl, and that thus:

$$\text{Birth-rate } (\tau) = c'.c'' \ldots K_1 v.$$

Now the birth-rate of τ is equal to the rate of the forward reaction (1) plus the rate of the back reaction (2), and since at equilibrium, rate (1) = rate (2)

$$\text{rate (1)} = c'.c'' \ldots K_1 v/2$$

and the rate constant k_1 is

$$k_1 = K_1 v/2 \ldots \text{(A)}$$

Applying van t'Hoff's isochor to K_1, we obtain:

$$\frac{d \log k_1}{dT} = -\frac{q}{RT} + \frac{d \log v/2}{dT}.$$

The second term on the right being negligible, this gives $k_1 \propto e^{-q_1/RT}$, that is, Arrhenius's equation.

The 'transition state method' of treating problems of reaction velocity consists in a generalization of this procedure to other variations than those of temperature. Supposing the reaction rate in solution changes under the influence of hydrostatic pressure π, then applying thermodynamics to equation (A) we obtain

$$\frac{d \log k_1}{d\pi} = \frac{V_1 - V_\tau}{RT} + \frac{d \log v/2}{d\pi},$$

where V_1 is the volume of a solution containing one mol of the initial state and V_1 the volume of a solution containing one mol of the transition state. We can again neglect the differential of v and set

$$k_1 \propto e^{(V_1 - V_\tau)/RT}$$

The fruitfulness of this deduction depends on our capacity to interpret the values of $V_1 - V_\tau$ derived from observation. This is easiest in the case of reactions of the type $A + B = AB$; for these we can predict $V_1 - V_\tau$ with some accuracy. The configuration of the transition state must here be intermediate between the configuration of the initial and final states and quite near to that of the final state, and the same will hold for the volume V_τ. V_τ will lie between V_1 and V_2 (the volume of the final state) close to V_2. This has, in fact, been confirmed by experiment. It thus seems that the rate at which reaction velocity varies with hydrostatic pressure is predictable for certain types of reactions.

The method is capable of further generalization. Variations in reaction velocity can be observed under the influence of an electric field, for example, when the rate of electrolytic evolution of hydrogen is governed by the polarization (ε) of an electrode. In this case we might write for the equilibrium constant K which relates the concentration of the hydrogen ions in solution to that of the hydrogen gas at the electrode,

$$\frac{d \log K}{d\varepsilon} = \frac{n}{RT},$$

where n is the effective (molar) charge of the proton. The effective charge is equal to $F = 96{,}500$ coulombs for the hydrogen ion which constitutes the initial state, and equal to zero for the final state when the proton is neutralized at the electrode. If we assume that in the transition state

the effective charge has an intermediate value, say, αn, α being about 0·5, we obtain

$$\frac{d \log K_1}{d\varepsilon} = \frac{\alpha F}{RT} \; ; \; \alpha \sim 0.5 \; ;$$

which on comparison of the differential of equation A with respect to ε and by neglecting $\frac{d \log v/2}{d\varepsilon}$ can be identified with $\frac{d \log k_1}{d\varepsilon}$. If we measure k_1 by the intensity i of the current, we have $\log k_1 \propto \log i$ and finally

$$\log i = \frac{\alpha F \varepsilon}{RT} + \text{const.} \; ; \; \alpha \sim 0.5 \; ;$$

which is the well-known over-voltage equation of Tafel. This equation is thus interpreted as indicating that the effective charge of the transition state lies about half-way between that of the initial and the final states of the reaction.

The field of such generalizations has been extended to other variations of reaction velocity arising from changes in chemical constitution, from the transfer of a reaction from the gas phase into solution, and from variations of solvents.

The principle consists in introducing a parameter of the transition state arising from the general equation

$$\frac{d \log k_1}{d\chi} = \frac{p_1 - p_\tau}{RT} \quad . \quad . \quad . \quad (B)$$

where χ is an external parameter causing the variation in reaction rate and $p_1 - p_\tau$ is the change in the corresponding parameter accompanying the formation of the transition state from the initial state.

The advance in the various directions to which I have referred is, as yet, tentative, but the method seems to provide a rational framework for the interpretation of many empirical rules of reactivity as well as a guidance to the discovery of new relationships.

References

The derivation of a reaction velocity from a statistical treatment of the transition state was first put forward by Wigner and Pelzer (*Z. phys. Chem.*, B, **15**, 445 ; 1932) in their treatment of the reaction $H + H_2^{para} = H_2 + H$; this treatment was generalized by Eyring (*J. Chem. Phys.*, **3**, 107 ; 1935) and by Evans and Polanyi (*Trans. Far. Soc.*, **31**, 875 ; 1935). The thermodynamic formulation equation (*A*) is due to the latter authors and to Wynne-Jones and Eyring (*J. Chem. Phys.*, **3**, 492 ; 1935). Equation (*B*) and its various applications sketched out in this paper are due to Evans and Polanyi (*Trans Far. Soc.*, **31**, 875 ; 1935 ; **32**, 1333 ; 1936).

Obituary Notices

Sir Albert Kitson, C.M.G., C.B.E.

Sir Albert Kitson, whose death occurred on March 8, was a geologist of world-wide repute, and the discoveries which he made and which are now being exploited in many parts of the world entitle him to be classed as one of the foremost economic geologists of his time.

Kitson was born in Manchester in 1868, but when six years old accompanied his parents to Australia. He entered the Civil Service of Victoria by competitive examination, and having a bent for geology he took courses in this subject at the University and School of Mines, Melbourne. Later on, he also took courses in mining and surveying, thereby equipping himself for the career which he was afterwards to follow.

As a result of his studies, Kitson was transferred to the Geological Survey of Victoria. In 1903 he became senior geologist, and while he occupied this post was responsible for some magnificent field work. In 1906 he went to Southern Nigeria as principal of the Mineral Survey, but resigned in 1911. In 1915 he was appointed director of the Geological Survey of the Gold Coast, which position he held until 1930 when he retired, having reached the age limit. So valuable were his services considered, however, that his period of service was extended five years beyond the usual period. It was while he occupied this position that his name became known in ever-widening circles, not only on account of the remarkable discoveries which have already been referred to, but also on account of the energy and drive which he put into his work. By many of the Gold Coast natives he was regarded as a fetish doctor owing to his seemingly reckless handling of snakes, an ability which he had acquired during his boyhood in the Australian bush. Nor did he know what fear meant. In the early days of his Southern Nigerian appointment, when he was geologizing in the wake of a punitive expedition, he was continually in trouble with the military authorities as he was always getting ahead of them.

Among Kitson's discoveries on the west coast of Africa may be mentioned the black and brown coalfields (Nigeria), manganese, bauxite, diamonds (Gold Coast) and many others of lesser importance, the development of which has contributed enormously to the prosperity of these two colonies. But he followed up these discoveries by coming home and describing their possibilities to interested parties in the business world of London for, as already indicated, he had the economic side of geology very strongly developed. Moreover, he was a great enthusiast and he managed by some subtle gift to impart his enthusiasm to others.

After his retirement, Kitson was requested by the Government of Kenya to carry out a preliminary geological survey with special reference to the

discoveries of gold which had begun to interest financiers. He therefore went out in 1932 and made his report. All his recommendations were accepted by the Government, and although Kenya may never become one of the world's great goldfields, the progress made since his report was written is quite remarkable.

Kitson was responsible for many papers; indeed he was a most prolific writer on his subject. In 1918 he was awarded the Wollaston Fund by the Geological Society and in 1927 the Lyell Medal. He was president of Section C (Geology) at the Johannesburg meeting of the British Association in 1929; and he attended geological and mining conferences in many countries, nearly always as a responsible delegate. On his retirement he was warmly commended by the Secretary of State for the Colonies for his services on the West Coast. He was knighted in 1927, having previously been awarded the C.B.E. in 1918 and the C.M.G. in 1922. Within recent years he joined the boards of several mining companies, a distinction which has seldom fallen to any geologist. He was actively associated with many scientific and technical bodies and on some of these the present writer, who knew him for many years, was also actively associated.

Kitson had always something useful to say when he did take part in discussions, and his keenness and his enthusiasm will be sadly missed. He was indeed a remarkable man as the foregoing will indicate; it falls to the lot of few to be as well known 'in the City' as in scientific circles.

WE regret to announce the following deaths:

The Duchess of Bedford, D.B.E., fellow of the Linnean Society, author of papers on ornithology, well known for several aeroplane flight records, lost during an aeroplane flight last week, aged seventy-one years.

Brigadier-General Sir Capel Holden, K.C.B., F.R.S., director of mechanical transport in the Ministry of Munitions during the Great War, on March 30, aged eighty-one years.

Prof. Dragutin Gorjanovitch-Kramberger, professor of palæontology and geology in the University of Zagreb, who in 1896 discovered the remains of early man of Krapina of Neanderthal type, aged eighty years.

Mr. C. E. Haselfoot, fellow (formerly dean) of Hertford College, Oxford, lecturer in mathematics in Wadham College, from 1888 until 1913, on October 28, aged seventy-two years.

Prof. Paul Janet, director of the School of Electricity, Paris, formerly professor of physics in the University of Paris, aged seventy-three years.

Sir Thomas Mottram, C.B.E., formerly H.M. Inspector of Mines, on March 24, aged seventy-eight years.

Prof. D. A. Low, emeritus professor of engineering in East London (now Queen Mary) College, on March 24, aged eighty years.

News and Views

Prof. A. Hutchinson, O.B.E., F.R.S.

BY the retirement of the Master of Pembroke College, Cambridge, Dr. Arthur Hutchinson, emeritus professor of mineralogy in the University, under the age limit of the new statutes, the University loses the services of one of its outstanding figures. For many years as lecturer in crystallography and demonstrator of mineralogy during the long tenure of the chair of mineralogy by the late Prof. Lewis, before himself succeeding to the chair in 1926, Dr. Hutchinson was the life and soul of that Department, and the inspirer of most of the original investigations carried on therein. His own contributions to original research were many and noteworthy, and his affectionate care for the valuable and ever-increasing collection of crystals and minerals in the New Museums, while at the same time it was kept usually available for actual study, was obvious to all who entered the Department; it was indeed often remarked upon by the many distinguished foreign mineralogists who visited Cambridge, and enjoyed the kindly hospitality of Dr. Hutchinson and his devoted wife, herself the sister of another eminent man of science, the late Sir Arthur Shipley.

AMONG the most useful of Prof. Hutchinson's contributions to the advance of his subject were his ingenious aids to graphical crystallography, such as the Hutchinson stereographic protractor and net, and his simplification of crystallographic calculations by graphical methods. Also his universal apparatus for the measurement and optical examination of small crystals, described to the Mineralogical Society in 1911, has proved to be of maximum utility at minimum cost. Again, in his work in collaboration with Dr. A. E. H. Tutton on the exceptionally interesting optical properties of gypsum at different temperatures, it was a clever device of Dr. Hutchinson which enabled the exact temperatures for the changes to be determined for the first time with absolute certainty. Indeed, extreme accuracy was characteristic of him, and another instance of it was afforded by his memoir on colemanite, in which he showed that the so-called neocolemanite was a myth, being identical with colemanite itself, the mistake of other observers having been due to inaccurate methods. Dr. Hutchinson's services to the Mineralogical Society, to the membership of which he was elected so long ago as 1890, can never be overestimated, whether

as member of council, foreign secretary, or president (1921–24). But fortunately, Dr. Hutchinson is retiring in excellent health, so that we may trust that his interest in the work of the Society may be long continued.

Prof. A. E. Trueman

The chair of geology in the University of Glasgow, rendered vacant through the resignation of Prof. E. B. Bailey on his appointment as director of the Geological Survey of Great Britain, is to be filled by Prof. A. E. Trueman of the University of Bristol. Prof. Trueman was educated at High Pavement School and University College, Nottingham, and he received the degree of D.Sc. in geology from the University of London in 1918. He was appointed assistant lecturer in geology at Cardiff in 1917, and head of the Department of Geology in University College, Swansea, in 1920. In 1933 he succeeded Prof. S. H. Reynolds as Chaning Wills professor of geology in the University of Bristol. Prof. Trueman is best known by his researches in problems of Coal Measures Geology. In particular, he has taken an important part in the zoning of the Coal Measures of South Wales by means of non-marine lamellibranchs, and in their correlation with other areas. He has also co-operated in research work carried out on dust from coal mines, in connexion with its bearing on the problem of silicosis among miners. In addition to his purely scientific work, Prof. Trueman has interested himself especially in the Workers Educational Association and other university extension activities. He is also a member of a committee appointed at Blackpool last year by Section C of the British Association to study the position of geology in the present educational system.

The National Government and Democracy

A pamphlet entitled "The Case for the National Government" by Earl de la Warr, chairman of the National Labour Committee, stresses the failure of democratic politicians to grapple with the problems of the new world with which the man of science is confronting this generation. In many countries they are unprepared for this new challenge of the scientific world, and the seriousness of the new problems and the pace at which solutions are demanded is too much for politicians either of the Left or of the Right. He believes that dictatorships have revived because democratic politicians have been unable or unwilling to adapt themselves to the new age and therefore have been weak and indecisive in dealing with modern problems. Earl de la Warr claims that Great Britain, in its National Government, is giving the democratic reply to conditions which have led to dictatorships elsewhere. Since we are finding our way into a new world, much of the work of the Government is necessarily experimental.

This new world is very largely the result of the discoveries and inventions of the chemist, the physicist, the biologist in the last hundred years or so. Science has given more to the world in that period than in any previous thousand years. Hitherto the politician has been concerned rather with the rights and liberties of man than with the possibilities of transforming everyday life by organizing the gifts of the scientific worker. The economic and social sciences have barely begun to keep pace with the physical and technical sciences. Nations should now be thinking not in terms of access to raw materials but to markets or even more of the creation of markets. The problems of to-day are the problems not of shortage as in the past but of plenty. The challenge of science cannot be met by limiting production or inventions but by dealing on rational and scientific lines with the factors which undermine national physique and welfare such as poverty, malnutrition, overcrowding. This is a matter of scientific organization whether of distribution, consumption, education or the like, and that such an approach is not easily turned into a fighting appeal to a democratic people is a real difficulty. Unless, however, democracy succeed in directing man's inherent pugnacity into fruitful and creative channels, the downfall of civilization is certain, and Earl de la Warr believes the National Government is an attempt to give a wise and courageous answer to many of these vexed questions.

English Terms in Scientific Writings

The S.P.E. Tract No. 48 (Oxford, Clarendon Press; 1937) contains three articles that are of interest to writers on scientific subjects. Mr. Otto Jesperson deals with the use of such terms and phrases as 'almost' before a verb or noun, 'kind of' or 'sort of', 'rather than', 'as much as', and so on. Sir W. A. Craigie notes many variations in the spelling of English words, but concludes that "the irregularities of modern English are of slight importance in relation to the language as a whole". Dr. C. G. Darwin's article on "Terminology in Physics" is reprinted from Nature (**138**, 908; 1936). His main points, it will be remembered, are: the difficulty of translating appropriately a term from a foreign language, the use of an inventor's name instead of a descriptive term, and the use of adjectives, such as 'microscopic' and 'macroscopic', to express opposite ideas by words of nearly the same sound and spelling. Others may be added to this list. For example, 'sismi', an equivalent for earthquakes, is simple to pronounce in Italian, and 'séismes' still more so in French, but the corresponding English term 'seisms' is intolerable. Another point is the formation of the singular of a word that has come down to us in the plural only. It would seem permissible, because natural and convenient, to use 'scree' as the singular of the Icelandic word 'screes'.

Popularization of Science

In an address on the "Popularisation of Science" when receiving the fellowship of the American Institute, New York, on February 4, "for interpreting to the people of the nation the rapid progress of science upon which modern civilization depends and for the organised dissemination of research findings

as news", Mr. Watson Davis said that the reporting and interpretation of science failed of its purpose if it did not bring about an appreciation and utilization of scientific method in everyday life. This he believed was best achieved by giving the mass of the people, through accurate and interesting accounts of science's successes and failures, some understanding of the essence of science which would lead them to apply it more widely to our everyday life, our human relationships, business and government. Many of the ideals we most cherished such as liberty, opportunity, the pursuit of happiness, freedom, democracy, were achieved by the utilization of scientific method, and the mistakes of democracy were best corrected by science.

THIS belief, that the only way of making democracy safe for itself was to make it more intelligent and accordingly more scientific, inspired the founders of Science Service, E. W. Scripps and Dr. W. E. Ritter. Many opportunities of such service were as yet only imperfectly used. For example, the scientific aspects of the recent disastrous floods had received little publicity, and the possibilities of books and magazines as media have yet to be fully developed. In this work quality is all important, and the first objective is the exact opposite of propaganda. It is to present facts in a readable and interesting form, on which the reader could base his own opinions on a subject of politics, sociology or his duty to his fellows. In recalling this statement of the founders of Science Service as to its objectives, Mr. Watson Davis emphasized that not even science must be allowed to become a dictator. It should set the example for straight thinking, confident that the process of democracy, guided by scientific method and reason, would give effective results.

Development of the Oil Engine

THE millions of compression-ignition oil engines in use to-day have all sprung from the initial work of Herbert Akroyd Stuart (1864–1927) and Rudolph Diesel (1858–1913), whose outstanding patents were taken out in 1890 and 1892 respectively. Vast sums of money have been spent by Governments, firms, institutions and individuals in experiments with oil engines, but just as the first successful Diesel engine was the outcome of the work during 1893–97 of the Maschinenfabrik-Augsburg-Nurnberg, so the success of the engine invented by Akroyd Stuart—known as the "Hornsby-Akroyd" engine—was due to the pioneering work of Messrs. Hornsby and Sons, Ltd., of Grantham, now Ruston and Hornsby, Ltd., of Lincoln. Having offered his patents to various gas engine makers, Stuart approached Messrs. Hornsby, and in 1891 they agreed to take up the development of Stuart's engine on a royalty basis. The necessary experimental work was entrusted to Mr. J. W. Young, who in a paper entitled "Notes on the Practical Development of the Oil Engine" read to the Newcomen Society on March 17, gave an interesting account of the difficulties which had to be overcome before the "Hornsby-Akroyd" engine could be placed on the market.

STUART'S principal patents were No. 7146 of May 1890 and No. 15994 of October 1890 and these covered compression ignition and airless injection, and also the use of a vaporizer. The most difficult problem was that of combustion, and many forms of vaporizers were tried. The construction of oil engines, too, demanded a higher standard of workmanship than the steam engines, and cylinders, pistons and piston-rings were all the subject of many experiments. Both fuel oil and lubricating oil raised many problems, especially as the oil refiners of that time had not succeeded in removing certain resinous bodies from the oil. In connexion with this, Mr. Young was sent to Russia, where Messrs. Nobel Brothers co-operated in introducing a uniform standard of distillation. As regards the development of the "Hornsby-Akroyd" engine Stuart took no part after 1891. He migrated to Western Australia about 1900 and died there on February 19, 1927. The so-called semi-Diesel engine is properly an Akroyd-Stuart engine, and nearly all makers of Diesel engines now use his method of airless injection, and not air-blast injection as introduced by Diesel.

Chair in Biblical Archæology: an Appeal

AN appeal for funds to endow a chair in biblical archæology in connexion with the Institute of Archæology of the University of London, has been issued over the signatures of the Archbishop of Canterbury, Sir Frederic Kenyon, Sir George Hill and Sir Charles Peers, should meet with a ready and liberal response, especially as the generous gift by Sir Charles Marston of £1,000 has already reduced substantially the amount which it is considered necessary to provide. Palestine demands of the field worker a widely extended and detailed knowledge of the general cultural and historical background, owing to its geographical position and its political, economic, and cultural relations with contemporary peoples. The institution of a chair in biblical archæology, by making provision for that preliminary training in acquisition and manipulation of the historical and cultural facts of the Ancient World, should go far towards conserving the time and energy of senior members of an expedition, which must be devoted to the training and supervision of the younger workers in the field. Not only does the installation of Sir Flinders Petrie's Palestinian collections at the Institute of Archæology make this an opportune moment to inaugurate such a chair, but also the results which have been achieved by recent excavation in Palestine, as for example at Lachish, Jericho and Gaza, as well as indications of the bearing of Palestinian material on the excavations now being carried out in Syria, all point in the direction of the imminent possibility of important additions to knowledge. This should be an additional stimulus to the British public, who have always looked kindly upon research in Palestine. Contributions may be sent to Mr. E. S. M. Perowne, 7 Great James Street, Bedford Row, W.C.1, or direct to the Westminster Bank, Marylebone Branch, 1 Stratford Place, Oxford Street, W.1, marked "Institute of Archæology".

Earliest Monumental Remains in Iraq

THE joint expedition of the American School of Oriental Studies and the University of Pennsylvania, in continuing the excavation of the mound site of Tepe Gawra in Mesopotamia, upon which it has been engaged now for several seasons, has uncovered some remarkable remains of a monumental character in the level of stratification now being explored. This level is the thirteenth from the surface in the series of some twenty strata of deposits of which preliminary exploration showed the mound to be composed before virgin soil was reached. Its culture is that of the 'painted pottery' people, of which evidence has been found wide-spread over early western Asia and the ancient East, from southern Russia to China, and dated at approximately 4000 B.C. and later. In a recent report from Prof. E. A. Speiser, field director of the expedition, according to a communication circulated by Science Service, Washington, it is stated that the expedition has discovered the acropolis of the city. It consists of a northern temple, eastern shrine and central temple, which with other buildings surround an open square, or court, paved with gravel covered with stamped clay. In the central temple, all the rooms show traces of a purple-red paint. The buildings are of an imposing character, and being the earliest known of their kind, carry back the practice of monumental architectural art to a much earlier phase of civilization than had hitherto been thought, while Tepe Gawra is shown to be the centre of an organized civic life, on a scale and of a kind for which hitherto there had been no evidence in connexion with the presumedly primitive people of the stone age to whom the painted pottery had been ascribed.

Soil Drift in South Australia

MR. F. N. RATCLIFFE, of the Council for Scientific and Industrial Research, Melbourne, has sent a long communication, for which space cannot be found, discussing an article in NATURE of December 19, based on his recent report on wind erosion (drift soil) in the arid pastoral belt of South Australia. Mr. Ratcliffe appears to hold the opinion that the processes taking place in that part of the world differ from the causes which have, and are, producing the man-made desert in other regions. The factors responsible for the destruction of the vegetation in Australia are drought, overgrazing by stock and the rabbit. The extension of the Sahara and the dust bowl in America are (omitting the rodent) being brought about by the same causes—excessive cultivation or grazing, or both combined. But the word 'drought' as used in Australia and America requires definition. This is the chief factor in the case. The actual results of the over-utilization are the same, whether the land is actually covered up by sand, or the top soil is blown away, or the soil deteriorates *in situ*: the spring water-level is lowered in the soil, not by *drought* as ordinarily understood by that word, but by the desiccation brought about by the acts of man. The end is a desert, and the water disappears from the surface and sinks to varying depths in the soil. As regards wind erosion, that is, dust storms, few travellers or inquirers who have studied desert regions, many of them man-made, can have failed to become acquainted with desert clouds of that type, whether consisting of sand or blown soil of valuable types. Mr. Ratcliffe has conceived the idea that the erosion or drift in Australia is something apart. It would appear to be only a type.

Oceanography in New South Wales

THE seasonal fluctuations in nutrient salts in European coastal waters and their bearing on the production of phytoplankton and ultimately on the fertility of the sea are now well understood. However, there are still huge areas of the waters of the world, including those adjacent to civilized countries carrying on original research, about which nothing whatever is known. Off the New South Wales coast, W. J. Dakin and A. N. Colefax ("Observations on the Seasonal Changes in Temperature, Salinity, Phosphates, and Nitrate Nitrogen and Oxygen of the Ocean Waters on the Continental Shelf off New South Wales and the Relationship to Plankton Production", *Proc. Linn. Soc. New South Wales*, **60**, 303–314; 1935. Sydney University Reprints, Ser. XIII (Zoology), **3**, No. 8; 1936) have now found complete exhaustion of both phosphate and nitrate by spring and autumn phytoplankton outbursts. The depletion of nitrate persists through the summer as in the seas around Great Britain, but phosphate is replenished more quickly. On the whole, nutrient salts are less than were found in the English Channel in the nineteen twenties but are not very different from the reduced quantities found there now. It is to be hoped that the investigations will be continued for a number of years to discover whether similar long-period fluctuations take place in Australian temperate waters, and further, that a well-found ship may be obtained to permit of investigations over a wider area unhandicapped by the difficulties of carrying on exact scientific work in the open ocean from the decks of a small yacht such as that at present in use.

Electricity Supply Tariffs

THE question of the standardization of electricity supply tariffs is of interest to many. A recent paper read by J. F. M. Mellor to the Students' Section of the Institution of Electrical Engineers on the basis on which those tariffs are founded is both a timely and a useful one. There are many difficulties in the way of getting an equitable solution to some of these problems. Take the case, for example, of an 'isolated consumer', that is, one who is at a considerable distance from the supply mains. In this case it is quite customary to charge the consumer the whole or part of the interest and depreciation on the capital cost of the mains extensions to his premises. It is reasonable, therefore, to expect that in the event of other consumers being connected on to these extensions, some refund should be made to the original consumer, and this should be mentioned in his agreement. The difficulty arises as to the period of time after the laying of the mains before the

liability of the supply authority ceases. Another difficulty is that the time of the peak load varies owing to the great increase in domestic water heaters and thermal storage apparatus which has recently occurred. In many places, when making a long-term agreement, no period of the day or night can now be regarded as 'off peak' and allowed for at a cheaper rate. A supply for a fixed number of hours per day at the lower rate can be arranged, but this is not so attractive to the consumer. Everyone agrees that standardization is desirable, but there are difficulties in the way until the many small undertakings in the country are amalgamated with the larger authorities. When this comes, a lowering of the tariffs will follow in the country districts, since the 'diversity' of the combined load will be increased and so less spare plant be required. A broader policy also can be adopted.

Education of Unemployed in the United States

EDUCATIONAL needs of unemployed young people are discussed in Bulletin, 1936, No. 18–3, entitled "Education for those out of School", recently published by a standing committee established two years ago by the United States Office of Education in co-operation with other Government agencies and educational leaders for the purpose of assisting communities and youth agencies, with the aid of youths themselves, to solve some of the problems overshadowing their outlook to-day (Washington, D.C. : Government Printing Office, 1936. 10 cents). This pamphlet, the third of a series of six bulletins issued by the committee, describes some of the plans that have proved serviceable to unemployed persons of ages 16–24 years. Of the twenty million persons of those ages in the United States, some four million are in full-time schools and colleges, nearly eight million are employed on full- or part-time jobs, and nearly five million are seeking employment.

ONE conclusion arrived at by the committee is that there is a large unsatisfied demand on the part of these young people, and especially girls, for training which will lead to, if it is not combined with, earning capacity. Another conclusion is that in the case of rural youth a combination of educational and recreational schemes is essential; neither the strictly educational nor the strictly recreational schemes have been found successful. Again, informal rather than formal procedures are desirable, and units of instruction and courses should be of short duration; for example, twelve to fifteen weeks to a unit with two-hour meetings once or twice a week. Above all, instruction should have specific goals and arouse a sense of achievement or arrival at a determined destination, and work should be so planned as to give a sense of continuity. Particulars are given of numerous schemes of vocational training for out-of-school youth which have been found to work well. The other bulletins of this series are entitled: how communities can help, leisure for living, vocational guidance for those out of school, finding jobs, and health protection.

Scottish Technical Colleges

THE Royal Technical College, Glasgow, reviews, in its report on the work of the session 1935–36, its own progress since its constitution in 1886 by the amalgamation of Anderson's College with a number of other separate institutions. In these fifty years, the number of its day students has increased from 124 to 1,001 and its gross income from £9,248 to £81,837. Among its more important developments during that time are the establishment of departments of architecture, textile manufacture, navigation, sugar manufacture, pharmacy and bakery, and the erection and equipment of new buildings at a cost of £400,000. Its counterpart in Edinburgh, the Heriot-Watt College, has far fewer day students (364) but its evening class students (2,460) are nearly as many as those of the R.T.C. Both colleges co-operate with city and county education committees in regard to the provision in continuation schools of courses preparatory to college courses. The Edinburgh college, however, records a serious falling off in the number of students from city continuation schools, and attributes this decline to lack of interest on the part of employers.

Heat and Power Station in Northern Russsia

ACCORDING to the Soviet Union Year Book Press Service, Grand Buildings, Trafalgar Square, W.C.2, plans have been completed for the building of a large heat and power station about twenty miles from Kotlas, a busy town in the northern province of the U.S.S.R. It will be built in virgin forest, near the site where building work is now proceeding in connexion with cellulose, chemical and wood-working enterprises for the Soviet timber and paper industry. This year the first section of the station with a capacity of 24,000 kW. will be brought into operation. It will have an annual output of 1·2 million tons of steam. Fuel will be provided by gas generated by pitch, a by-product from the local timber and chemical industries. Four boilers will produce 60–80 tons of steam per hour, at a pressure of 35 atmospheres, the steam passing into turbines of 12,000 kW. each. These boilers are fitted with special fuel jets for the new form of fuel. The turbines can run at various steam pressures, depending on the requirements of production.

The Midwifery Service

THE annual report of the Central Midwives Board for the year ended March 31, 1936, has been published (London : H.M. Stationery Office. 2*d*. net). It shows that there were 62,064 women on the midwives roll, an increase of 3,100 on the total for the previous year, although only a little more than a quarter of the total number of qualified midwives are actually engaged in the practice of their profession. The report states that during the year the Board approved a final draft of new rules for training and examination, which has since been submitted to the Minister of Health. The report also includes notes on interesting decisions given by the Board during the year on midwifery etiquette and practice.

German Institute of Psychological Research

A GERMAN Institute of Psychological Research and Psychotherapy has been founded under the auspices of the German Home Office. The members consist of representatives of the Pan-German Medical Society of Psychotherapy, the German Psychoanalytic Society, the Künkel co-operative group for "Applied Study of Character" and other well-known psychotherapeutists. The functions of the Institute will be (1) research, (2) educational and teaching activities, and (3) maintenance of a clinic for the indigent. The director is Prof. M. G. Göring, president of the Pan-German Medical Society of General Psychotherapy.

Public Health Investigation in India

Two Indian institutes have recently issued their reports. That of the All-India Institute of Hygiene and Public Health, Calcutta, for 1935 reviews the courses of instruction that have been given and summarizes the research work carried out. The last-named includes epidemiological studies on cholera and studies upon the chemical constitution of the cholera vibrios by Dr. Linton, the epidemiology of epidemic dropsy and the ætiology of black-water fever. Diet surveys of certain sections of the population and field studies upon malaria have also been carried out. The second report, that of the Haffkine Institute, summarizes the Institute's work for 1932–35. Plague investigations have been continued, and more than two million doses of plague vaccine were issued in 1933–34; Drs. Sokhey and Maurice have prepared a curative plague serum which experimentally possesses greater potency than any sera previously prepared. Anti-rabic treatment is also provided at the Institute, and 2,274 cases were treated during 1935, with a mortality rate of 0·17 per cent.

Natural and Artificial Manures

THE Ministry of Agriculture has issued a new and enlarged edition of Bulletin 36, "Manures and Manuring" (H.M. Stationery Office, price 2*s.*). A number of additions have been made since the last issue, the preliminary section dealing with the principles that govern the manuring of farm crops having been specially expanded. As before, the bulletin is divided into three main sections, namely, organic manures, artificial fertilizers and the purchase and use of artificial manures. The information is essentially practical, and should enable the farmer to make the fullest use of the wide variety of fertilizers now available. In view of the differences in local conditions, complete generalizations are of course impossible, and in the event of uncertainty the farmer is advised to consult the agricultural organizer for the county in which he resides. A pamphlet (Form *A.* 705/*TG.*) giving names and addresses of advisory staffs may be obtained free on application to the Secretary of the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1.

Broadcasting of Cosmic Data

A REGULAR schedule of broadcasts of cosmic data and scientific news was inaugurated at Boston, U.S.A., on February 1 by the World Wide Broadcasting Foundation's short-wave station in co-operation with the Union Radio Scientifique International and Science Service. The primary purpose of these broadcasts is to make available internationally technical data on observations of sunspots, solar radiation, magnetism, ionized layer heights and other phenomena observed during the same day, and to interest laymen in making observations. The broadcasts will be heard daily from 4.55 to 5.00 p.m. (Eastern Standard Time) on 25·4 metres and weekly summaries on Monday evenings from 8.30 until 8.45 p.m. on 49·6 metres. The Monday evening broadcasts will be a weekly compilation. The programme inaugurating this service included brief talks by Dr. A. E. Kennelly of Harvard University, the co-discoverer of the Kennelly-Heaviside layer; Dr. Harlow Shapley, director of the Harvard College Observatory, and Watson Davis, director of Science Service, Washington.

Science Abstracts

THE issue of the two index numbers of vols. 39 of *Science Abstracts* for 1936 enables a comparison to be made with previous volumes. The physics volume includes 5,716 abstracts covering 1,332 pages, with a subject index of nearly 260 and an author index of more than 80 pages. The electrical engineering volume has 3,525 abstracts in 820 pages, with subject index 120 and the author index 55 pages. The former volume is about six per cent larger than last year's and the latter about eleven per cent. The average length of the abstracts is slightly less than last year. The subject index in the physics volume has a key to it which facilitates its use. Each volume of *Science Abstracts* is a valuable time-saving device for those who wish to keep abreast of research or look up past progress in the subject with which it deals.

Prof. T. C. Hodson: a Correction

PROF. T. C. HODSON writes to point out in reference to the announcement of his impending retirement from the professorship of social anthropology in the University of Cambridge (see NATURE, March 20, p. 497), that he did not take a degree at Queen's College, Oxford, and that during the War, his service with the Indian forces covered a brief period only, when he was transferred to Railways and later to Forestry G.H.Q., where he took over from the late Lord Lovat. It should be added that Prof. Hodson was honorary secretary of the Royal Anthropological Institute in 1912–1914–15.

Comet Whipple (1937*b*)

USING observations made at Harvard on February 4, at Norwood on February 26 by Steavenson, and on March 11 and 12 by Hay at Hendon and Steavenson at Norwood, respectively, the Rev. Dr. M. Davidson has computed the following orbit: *T*, 1937

June 19·96971 U.T.; ω, 107° 25′ 56·0″; Ω, 127° 57′ 11·0″; *i*, 41° 43′ 31·7″; *e*, 1·009143; *q*, 1·739393. The orbit fits in with a number of other observations, but in many cases there are residuals of the order 1^s in right ascension. The object must be difficult to observe accurately as even on the same night discrepancies of about 1^s arise between different observers. Generally speaking, the residuals in declination are small.

Announcements

SIR THOMAS HOLLAND will deliver the Huxley Memorial Lecture in the Huxley Building of the Imperial College of Science and Technology, South Kensington, on May 4, at 5.30. The subject of Sir Thomas's lecture will be "The Permanence of Oceanic Depressions and Continental Elevations".

THE George Darwin Lecture of the Royal Astronomical Society will be delivered by Prof. N. E. Nörlund at the ordinary meeting of the Society on May 14. His subject will be "Astronomical Longitude and Azimuth Determinations".

DR. SIMON FLEXNER, director of laboratories of the Rockefeller Institute, New York, has been elected a foreign associate of the Paris Academy of Sciences in succession to the late E. P. di Sessa.

PROF. JULIUS WAGNER-JAUREGG, professor of psychiatry and neurology at the University of Vienna and pioneer in the malarial treatment of general paralysis, celebrated his eightieth birthday on March 7.

A CORRESPONDENT, writing with reference to the article in NATURE of March 27 on the work of the Department of Scientific and Industrial Research, informs us the fundamental research on the setting of keratin (p. 535) in the manner used in 'permanent waving' is due to Dr. J. B. Speakman, of the Textile Department of the University of Leeds, and not to the Woollen Industries Research Association. In the first paragraph of the leading article of the same issue, the reference to Mr. D. R. H. Wilkins should have read Mr. D. R. H. Williams.

THE Central Executive Committee of the U.S.S.R. has conferred the Order of Lenin on Prof. A. N. Bach, on the occasion of the fiftieth anniversary of his scientific activity, and for his outstanding services in the field of biochemistry. Prof. Bach celebrated his eightieth birthday on March 17. During his half-century of scientific research, he has published about 120 works, mostly dealing with problems of biochemistry. The three fundamental problems to which he devoted his energies were the chemistry of photosynthesis, respiration and enzyme action.

THE National Trust announces that through the generosity of Mrs. Pollard, honorary secretary of the Cornwall branch of the Council for the Preservation of Rural England, the beautiful cliff lands extending for three quarters of a mile from Mullion Cliffs at Porth Pyg about a mile and a quarter south of Mullion to the north end of Prodannack Head have been preserved by means of covenants in connexion with which part of the land will pass into the actual ownership of the Trust. The Tehidy Minerals Co., Ltd., has generously co-operated in regard to the mineral rights which it owned. The Trust will now be protecting eighteen coastal properties in Cornwall.

THE forty-second Annual Congress of the South-Eastern Union of Scientific Societies will be held at Hastings on June 8–12, under the presidency of Prof. F. E. Weiss. The title of Prof. Weiss's address will be: "Competition and Co-operation in Nature." Further information can be obtained from the honorary general secretary, Mr. W. C. Fishlock, 19 South View Avenue, Reading.

UNDER the terms of the Thomas Gray Memorial Trust, the Royal Society of Arts is offering a prize of £75 to any person for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation; and a prize of £25 for an essay on "The Stability of Ships". Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

A SPECIAL Summer School and Conferences on Strength of Materials will be held at the Massachusetts Institute of Technology for four weeks beginning on June 21. The following subjects will be considered: creep (Dr. A. Nadsi and Mr. C. R. Soderberg); fatigue (Dr. H. J. Gough); strength of materials (members of the Institute staff). Further particulars may be had by communicating with Prof. John M. Lessells, Department of Mechanical Engineering, Massachusetts Institute of Technology, who is director of this Summer School.

ON April 30, a joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) will be held in Washington. A group of papers on the more fundamental scientific aspects of radio communication, including radio measurements, radio circuit theory, radio transmission phenomena including ionosphere phenomena will be presented. The meeting is open to the public. Further information can be obtained from R. C. Ould, 3747 Huntington Street, Washington, D.C.

THE sixth Italian Congress of Microbiology will be held at the Milan Institute of Serotherapy on April 21–24. Further information can be obtained from Segretaria del Congresso, via Darwin 20, Milano 124.

THE twenty-eighth Congress of the German Röntgen Society will be held in Breslau under the presidency of Prof. Pleikart Stumpf of Munich on April 12–14, when an exhibition of X-ray apparatus will also be held. Further information can be obtained from Fachgruppe Elektromedizin, Corneliusstrasse 1, Berlin W.15.

two fixed points, but he was less critical and less rational than Rømer in choosing these points. He retained the freezing point, measured in melting ice, as one fixed point, but he obviously wished to avoid the use of a standard thermometer for fixing the second. He had termed water of 22½° Rømer (28·5° C.) "blutwarm", and in this way conceived the idea of using a slightly higher temperature for the second fixed point, namely, body temperature measured "when the thermometer is placed in the mouth or arm-pit of a healthy man and held there until it acquires the temperature of the body"[4]. This temperature (about 36° C. or 26½° Rømer) is not particularly constant, and Fahrenheit therefore felt the need of a further fixed point as a check. It appears indirectly from a letter sent from Copenhagen to the Royal Society in 1709[5] that it had been discovered that the zero on Ole Rømer's thermometer "very nearly approaches the Point of Artificial Freezing". Fahrenheit must also have been aware of this, and therefore used the temperature of a freezing mixture for checking his zero. He admits that this temperature (like body temperature) is not quite constant, but his experimental skill enabled him to use the two not very reliable fixed points to check one another, and hence to make thermometers which were satisfactorily concordant according to the standards of the times.

The figures for the fixed points on Fahrenheit's earliest thermometers were :

0° ; 7½° ; 22½° ; *as on Rømer's thermometers*, or 0° ; 30° (= 4 × 7½°) ; 90° (= 4 × 22½°) by dividing the degrees into four parts. Later he altered these figures to

0° ; 32° (= 4 × 8°) ; 96°, probably for convenience in calculation (as also suggested by Dr. Newton Friend).

Since the temperature 90° F. (corresponding to 26½° Rømer) is higher than Rømer's 4 × 22½°, Fahrenheit's degrees are larger than those of Rømer : hence if the graduation is continued in the same units, Fahrenheit's boiling point will be designated by a smaller number than Rømer's, namely, 212° instead of 240° (= 4 × 60°).

We thus see that Fahrenheit's scale is derived from that of Rømer. The honour of founding a great advance in temperature measurement is due to Rømer, but, like many of his other discoveries, it has passed unnoticed. Fahrenheit's skill in making thermometers enabled it to be put to general use, though in a somewhat incomplete form.

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[1] Nature, **139**, 395 (1937).

[2] For a detailed review, see Kirstine Meyer, Nature, **82**, 296 (1910).

[3] Quoted from "Daniel Gabriel Fahrenheit", by Ernst Cohen and W. A. T. Cohen-De Meester. *Verhandl. der koninklijke Akademie van Wettenschappen te Amsterdam.* Afdeeling Natuurkunde, Deel XVI, No. 2. Amsterdam, 1931. The authors have translated the letter from Dutch to German.

[4] *Phil. Trans.*, **33**, 73 (1724).

[5] *Phil. Trans.*, No. 324 (1709) ; cf. Nature, **82**, 297 (1910).

In historical matters there is always room for divergence of opinion when the principals concerned, long since passed away, have left behind insufficient details to enable us to reconstruct the entire picture.

I am sorry that Dr. Kirstine Meyer does not accept my suggestion that Rømer's zero was obtained with a mixture of ice and salt (or sal ammoniac). We are all agreed that Rømer chose the boiling point of water as his upper fundamental fixed point and named it 60°. Dr. Meyer would have us believe that, as his lower fundamental fixed point, Rømer chose the temperature of melting ice, called it 7½° and evaluated his zero "by marking off 7½ parts of the same size below the freezing point".

I cannot believe that the great astronomer could be so inartistic as to choose arbitrarily the curious figure of 7½ for his lower fundamental fixed point. This number, however, ceases to be curious if the scale had already been fixed with reference to a zero whereby the temperature of melting ice became an *incident* on the scale and not its *origin*.

Are we to believe, with Dr. Meyer, that it is a pure coincidence that Rømer's zero corresponds to the eutectic temperature of ice and salt—a mixture that was already well known in Boyle's time ? I think the paper in the *Phil. Trans.*, to which Dr. Meyer refers, will bear quite a different interpretation from that suggested by her.

Further, are we to assume that Fahrenheit, who copied Rømer's scale—not surreptitiously, for he openly acknowledged it—and Rømer's methods in their entirety, did not also copy the method of obtaining his zero from Rømer ?

Piecing all these points together, it appears to me that the balance of evidence distinctly favours the view expressed in my article, and I am extremely sorry to have to join issue with so great and well known an authority on Danish thermometry as Dr. Kirstine Meyer.

Having once devised his scale, there was nothing to prevent Rømer from preparing standard thermometers as described in "Adversaria", using as *control* points 60° and 7½° respectively. This is what one would expect, for the construction of a standard thermometer would naturally follow, rather than precede, the selection of the scale. Once the scale had been selected, any suitable control points could be used, as at the present time, in the graduation of standard instruments. Dr. Meyer has clearly confused this latter operation, as described in "Adversaria", with the invention of the scale itself, which is not described either in "Adversaria" or anywhere else so far as we know. Hence my suggestion as to its probable origin, and my statement which Dr. Meyer finds "difficult to understand".

I am sorry that Dr. Meyer is so critical of Fahrenheit's part, for Denmark owes much to Fahrenheit ; without him Rømer's scale would undoubtedly have sunk into oblivion like that of Newton. Newton's scale was a much more convenient one and antedated Rømer's by at least a year ; but Newton had no Fahrenheit to commercialize his thermometers and thus bring his scale into common use.

Personally, I wish Rømer's scale had also remained a historical curiosity and that the centigrade scale alone had survived. It would have saved much inconvenience to many of us.

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Bleaching of Visual Purple in Solution

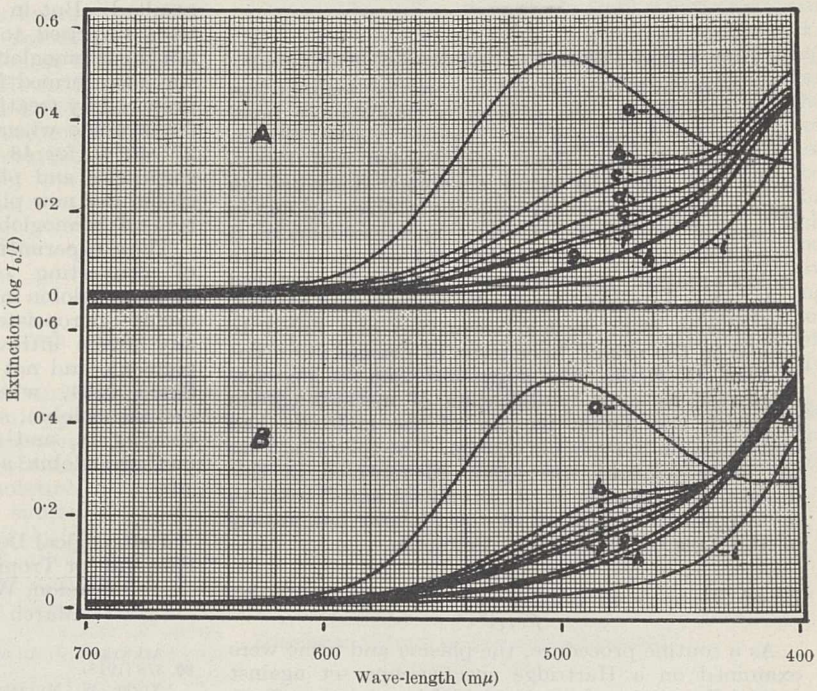
A NEUTRAL solution of visual purple exposed to bright light bleaches almost instantly to a deep orange colour, then more slowly to pale yellow. This transition has been believed to be wholly photochemical; the orange material a mixture of unbleached visual purple with the final yellow residue[1]. Both assumptions are mistaken: the orange photo-product is new pigment, which fades to yellow in complete darkness.

I have examined these processes with a recording photo-electric spectrophotometer[2], with which complete spectra were registered within two minutes, and in the case of visual purple could be completely retraced without perceptible bleaching.

Visual purple solutions from marine fishes (scup, sea robin, sea bass, killifish), summer and winter frogs, rabbits and rats behaved identically in these experiments. Typical data obtained with bull frog visual purple in 1 per cent aqueous digitonin, buffered at *p*H 6·9, are shown in Fig. 1. Half the preparation was measured four hours after extraction (*A*), the remainder one week later (*B*). The curves show the spectra of whole extracts, measured against an equal depth of distilled water.

The original solutions possess a single broad absorption band, maximal at 500 mμ (curves *a*). They were exposed for ½ minute to bright light (700 ft. cdles.) and the spectra immediately re-measured (curves *b*). The orange-coloured photo-product possesses a broad absorption band maximal at about 480 mμ, and higher absorption than visual purple itself below 430 mμ.

The solutions were left in position in complete darkness, and their spectra periodically re-measured, curves *b* at 1·2 minutes, *c* at 3·2 and 3·7, *d* at 7·2 and 8, *e* at 13·8 and 15·7, and *f* at 32·2 and 32·8 minutes (29·3° C.). (Times are from the beginning of irradiation to the recording or the extinction at 500 mμ. When two times are given, the first refers to *A*.)



At 35 minutes the preparations were re-irradiated as before for 40 seconds and their spectra recorded (curves *g*, 37 minutes). At 38·5 minutes they were exposed for a third time, and yielded curves *h* (40 minutes). Curves *f* to *h* show the bleaching of a small amount of visual purple, probably re-generated during the period in darkness[3].

Of the total fall in extinction from curves *a* to *f*, 31 per cent at 500 mμ and 42 per cent at 480 mμ are due to 'dark' processes. These may in turn be analysed into two components. One, a slow, general fall in the entire 'bleached' spectrum was discovered by Hosoya[4]. I have found it to appear clearly only in fresh preparations. It is prominent in *A*, recorded several hours after extraction, but has vanished completely from this preparation after a week's storage (*B*). The second 'dark' component, shown isolated in *B*, rapidly obliterates the initial 'bleached' maximum at 480 mμ, with simultaneous rise in absorption below 435 mμ. This is an invariable element of the bleaching of neutral visual purple solutions. In *B* it alone accounts for 19 per cent of the fall in extinction from curves *a* to *f* at 500 mμ, and 26 per cent of that at 480 mμ.

The final product of bleaching (curves *h*) is a relatively stable yellow material, the spectrum of which is slightly inflected at 405–410 mμ, and which absorbs more strongly than visual purple itself below 420–430 mμ.

Chase[5] has observed striking differences in the course of bleaching at various *p*H's. I find these to depend principally upon changes in the 'dark' components. In acid solution (*p*H 3·9) the initial photo-product possesses an almost symmetrical absorption maximum at about 440 mμ, which progresses slowly in light or darkness into the ultra-violet, leaving finally only the terminal absorption of a stable, deep yellow end-product. With decrease in acidity the 'dark' processes accelerate greatly. At *p*H 10·5 no 'dark' reaction has yet been detected, presumably because it is too rapid for measurement; irradiation yields almost immediately a stable, very light yellow material, the absorption of which still rises above that of visual purple below 410 mμ. The final product is really the same at all *p*H's; its colour varies reversibly with *p*H[5].

Under all known conditions, therefore, visual purple bleaches to new pigments. At 400 mμ, increases in absorption, the reverse of bleaching, are invariably observed. The common representation of the visual purple spectrum as the difference in absorption between unbleached and bleached preparations[6] is therefore physically meaningless.

The final yellow residue, extracted with benzine containing 1 per cent ethanol, yields all colour to the benzine. The yellow pigment, returned to buffered aqueous digitonin solution, possesses a spectrum similar to that of the whole 'bleached' residue (curves *i*). It exhibits the same *p*H colour changes

as the entire residue. In chloroform, tested with antimony trichloride, it yields the deep blue colour and sharp absorption band at 664 mμ characteristic of retinene[7]. Though in the retina retinene is involved in further changes[7], it is the final product of bleaching in solution.

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[1] Kühne, W., *Hermanns Hdbch. der Physiol.*, Bd. 3, 308 (1879).
[2] Hardy, A. C., *J. Opt. Soc. Amer.*, **25**, 305 (1935).
[3] Kühne, W., *J. Opt. Soc. Amer.*, **25**, 321; Hecht, S., Chase, A. M., Shlaer, S., and Haig, C., *Science*, **84**, 331 (1936).
[4] Hosoya, Y., *Arch. ges. Physiol.*, **233**, 57 (1933).
[5] Chase, A. M., *J. Gen. Physiol.*, **19**, 577 (1935–36).
[6] König, A., *Sitzungsber. Akad. Wiss. Berlin*, 577 (1894); Köttgen, E., and Abelsdorff, G., *Z. Psych. Physiol. Sinnesorg.*, **12**, 161 (1896)
[7] Wald, G., *J. Gen. Physiol.*, **19**, 351, 781 (1935–36).

A New Blood Pigment: Pseudo-Methæmoglobin

In addition to oxyhæmoglobin, methæmoglobin has been recorded in the plasma of blackwater fever patients by Arkwright and Lepper[1], Yorke, Murgatroyd and Owen[2], Ross[3] and Fairley and Bromfield[4]. In 1934 the latter observers[5] described an unnamed pigment closely allied to methæmoglobin in a case of blackwater fever. Spectroscopically it resembled methæmoglobin, but did not reduce with Stokes's reagent or ammonium sulphide. It produced a chocolate-coloured blood, a brown-coloured plasma, was absent from washed corpuscles and failed to appear in the urine. Specimens of plasma were sent to Prof. D. Keilin, who suggested that the pigment originated as some modification of methæmoglobin in which the globin portion of the molecule had undergone an irreversible change. The following year the same pigment was again encountered in this disease, and recently R. J. Bromfield and I went to investigate this question at the Malaria Laboratory of the League of Nations, Salonika.

Blood Pigments in Macedonian Cases of Blackwater Fever

As a routine procedure, the plasma and urine were examined on a Hartridge spectroscope set against artificially produced methæmoglobin, and the effects of treatment with Stokes's reagent, ammonium sulphide (10 per cent) and hydrogen peroxide (10 vols.) were noted. All these reagents disperse the α band of true methæmoglobin, but not that of the new pigment. Fourteen cases were investigated. The plasma contained oxyhæmoglobin alone in two mild cases, new pigment alone in two severe cases seen on the third and sixth days respectively, and new pigment and oxyhæmoglobin in the remaining ten. In not a single instance was methæmoglobin demonstrated.

The urine, on the other hand, never contained new pigment in demonstrable quantity. Oxyhæmoglobin was found alone in two instances and in association with methæmoglobin in ten others; in the two remaining cases the urine contained no blood pigments, though new pigment was demonstrated in the plasma. All the available data indicated that the new pigment did not traverse the glomerulus, and that urinary methæmoglobin was derived from oxyhæmoglobin during or after its passage through the tubules. Microscopic examination of the kidneys showed that the formation of new pigment protects them from the pathological effects induced by the renal excretion of hæmoglobin.

Finally, in a series of spectrograms taken for us by H. Foy, the centre of the α band of the pigment in the plasma always approximated to 6240 A., whereas that of the urine was constantly about 6300 A. Evidence regarding the duality of these pigments was thus complete.

Production of Pseudo-methæmoglobin in Vitro

The formation of methæmoglobin in sterile blood or hæmoglobin solution stored under ordinary conditions or after incubation at 37°–55° C. has long been recognized. To ascertain whether the new pigment could be produced *in vitro*, plasma from blackwater fever patients was incubated at 37°–40° C. for 48 hours with a concentrated solution of hæmoglobin prepared from laked corpuscles. The new pigment invariably resulted. But in controls, using normal plasma, we were surprised to find that the new pigment, and not methæmoglobin, appeared. The new pigment was also formed from a solution of methæmoglobin prepared by treating laked corpuscles with potassium ferricyanide when it was incubated with plasma at 37°–40° C. for 48 hours. The incubation of unlysed corpuscles and plasma produced neither methæmoglobin nor new pigment, while on incubating a solution of hæmoglobin alone, methæmoglobin formed.

These experiments prove that plasma has the power of converting extra-corpuscular hæmoglobin or methæmoglobin into the new pigment when incubated under appropriate conditions, and suggest that in any severe intravascular hæmolysis it is this new pigment, and not methæmoglobin, which is formed. Since 1864, when Hoppe-Seyler[6] first described methæmoglobin, this allied pigment has escaped recognition, and for this reason the name pseudo-methæmoglobin appears to be a not inappropriate one.

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[1] Arkwright, J. A., and Lepper, E. H., *J. Roy. Army Med. Corps*, **30**, 378 (1918).
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Effect of Testosterone Propionate on Mating

Much has been written recently about the effectiveness of testosterone in restoring the atrophic accessory glands of castrated rats, but little, if any, attention has been paid to its effect on mating behaviour.

Five rats were castrated at 30–50 gm. body weight, that is, well before sexual behaviour begins, and were kept isolated for nine weeks, when they were put with normal females. They showed no sexual behaviour. The following day they were again isolated and a course of eighteen daily injections of 0·5 mgm. testosterone propionate ("Perandren" Ciba) was begun. Development and hyperæmia of the penis

was evident within a week of the beginning of treatment. Females were put into the cage eight days after the beginning of the injections and attempts at mating were observed. Two vaginal plugs, indicating that two males had mated and that their seminal vesicles and prostate were well developed, were found next day. After twelve days' treatment, the five males were separated and each given five females. Within five days all the males had mated (as determined by the occurrence of vaginal plugs), one of them repeatedly.

Prepubertally castrated male rats are not known to mate. They would in any case be unable to leave vaginal plugs, so that the results described above must have been due to the treatment with the testosterone propionate, which stimulated the development of the penis and the secretory activity of the accessory glands and induced mating behaviour. Since removal of the seminal vesicles and the prostate of normal rats does not eliminate the mating reflex[1], the appearance of this reflex is not likely to be a mechanical effect due to distension of the glands.

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[1] Steinach, *Pflugers Archiv.*, **56**, 304 (1894).

Stimulating Materials obtained from Injured and Killed Cells

PREVIOUS work of ourselves[1] and others[2] has shown that ultra-violet radiation appears at times to stimulate cell division in micro-organisms, but that there is little consistency in obtaining the effect. To establish whether or not stimulation of metabolic processes occurs when cells are subjected to lethal ultra-violet irradiation, the respiration of yeast suspensions irradiated with full ultra-violet under various conditions was compared with that of controls. Again inconsistent results were obtained, but definite stimulation occurred in a number of cases. There then followed an investigation of various factors, such as *p*H, age of organisms, quality and quantity of radiation, etc., which might have accounted for the inconsistencies.

The results of these investigations suggested that the apparent stimulation of respiration might be caused by materials from the injured or killed cells which affected surrounding cells, and that the depression observed in many cases was the result of the killing of so many cells in the irradiated suspensions that too few were left to produce a respiratory effect equal to that of the control. To test this hypothesis, cells irradiated until they no longer respired were added to non-irradiated cells. Under these conditions, stimulation was uniformly obtained.

Following these results, suspensions of yeast were irradiated for a sufficient time to kill all the cells present, the suspensions were centrifuged and filtered through a Seitz bacterial filter, and the cell-free fraction and remaining dead cells added to separate suspensions of normal cells. The dead cells caused an average increase of about ten per cent in respiration (in terms of the technique used), while the cell-free extract produced an average increase of about fifty per cent. Further studies showed that cell-free extracts from cells injured or killed by X-rays, heat, or mechanical injury gave comparable results. The effect was not confined to micro-organisms—cell-free extracts from irradiated liver, kidney and embryo tissues, etc., also showed it.

Studies of the proliferation-promoting power and fermentation stimulation of some of the extracts were made, using yeast as a test organism. Definite stimulation was obtained in all cases. The preliminary results obtained thus far indicate that materials from different sources, prepared in different ways, show different orders of potency with regard to stimulation of respiration, proliferation and fermentation, suggesting the existence of at least three substances responsible for the effects. Some preparations were subjected to dialysis. The active materials passed through the dialyzing membrane, leaving inactive residues behind.

Experiments are under way with cell-free fractions, prepared by different methods from micro-organisms and tissues of various kinds, in which parallel respiration, proliferation and fermentation tests are being compared with the ultra-violet absorption spectra of the concentrates with the view of elucidating the chemical nature of the active components. Some of the materials resemble in their biological properties bios preparations from yeast and malt combings. The spectra, however, indicate wide variation in the chemical nature of the substances present. Which of the compounds the presence of which is indicated by the spectra are active materials and which are impurities remains to be determined. Some of the spectra show the presence of large quantities of nuclear purines and pyrimidines, the relation of which to the lethal action of the ultra-violet has already been noted[3].

We are particularly interested in the possible relation of these materials to the mechanism of tissue repair after injury and to the mechanism of malignant growth.

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[1] Sperti and Schneider, *Bull. Bas. Sci. Res.*, , 32 (1926). Loofbourow and Cameron, *Bull. Bas. Sci. Res.*, **5**, 33 (1933).

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Electrical Conductivity of a Supraconducting Sphere in the Intermediate State

A SPHERICAL single crystal of tin was placed in a magnetic field at a temperature below T_k. The electrical conductivity was determined (by measuring the current in a supraconducting circuit) for various directions of the current with regard to the magnetic field. It was found that the sphere remained supraconducting in the direction of the field up to field-strengths very nearly equal to H_k. In the direction perpendicular to the field, supraconductivity vanishes at field strengths near $2/3\ H_k$. In other directions supraconductivity is destroyed in the interval of field-strength between $2/3\ H_k$ and H_k.

It is well known that for a supraconducting sphere at field-strengths greater than 2/3 H_k the magnetic permeability μ is no longer equal to zero, while macroscopic measurements show that the sphere is magnetized homogeneously[1]. Peierls[2] named this the 'intermediate state' and assumed it to consist of supraconducting and normal regions. Landau[3] calculated that these regions have a definite structure and orientation depending on the external field and the field caused by the current.

Our experiments show that in the intermediate state the sphere possesses anisotropic supraconductivity and, when the direction of the current is parallel to the external field, can remain supraconductive right up to the field strength H_k, that is, even when μ is very near to unity.

A detailed report will be published shortly in *Sow. Phys.*

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[1] de Haas and Guineau, *Physica*, **3**, 182 (1936).
[2] Peierls, *Proc. Roy. Soc.*, A, **155**, 613 (1936).
[3] Landau, *Sow. Phys.*, in the Press.

Band Spectrum of Manganese Hydride, MnH

Following on previous work in which we observed the spectrum of nickel hydride[1], NiH, in a high-tension arc between nickel electrodes in a flame of hydrogen burning in air, we have made similar experiments with other metals. With manganese, four bands with open rotational structure have been observed. The strongest band is in the yellow-green; it is degraded to the violet, and shows a rather complicated rotational structure; there is a strong head at λ 5678, and a fainter one at λ 5722. Bands in the green (heads at λ 5172 and λ 5205) and red (head at λ 6240) have a rather similar appearance, and the three bands may be considered tentatively as the (1,0), (0,0) and (0,1) bands of the same system. There is also a band in the blue; this is degraded to the red and has a simpler rotational structure than the other bands; its head is at about 4500 A.

The spectrum has also been produced in a discharge tube; in this the bands are rather masked by the molecular spectrum of hydrogen, but their production in this source, which does not contain oxygen or nitrogen, strengthens the assignment of the bands to MnH.

(Feb. 24.)

Since writing the above, our attention has been attracted to a note on the spectrum of manganese hydride by T. Heimer[2], who has already recorded the three bands in the red, yellow-green and green which we described, and has made the same assignment of vibrational quantum numbers. In the blue, the very close band structure in the region 4700–4850 A. which Heimer records is not the structure which we described. The latter is much more open and forms a head at λ 4500. Further scrutiny of our plates shows that the band obtained by Heimer is also present. On the more strongly exposed plates the two structures run into one another and are possibly closely related.

The manganese atom has as its ground state the configuration

$$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2 \qquad {}^6S,$$

and it therefore seems likely that in the formation of MnH the ground-level will be either $^5\Sigma$ or $^7\Sigma$. If the rule of Heitler and London is obeyed, then only the $^5\Sigma$ level will be stable. Transitions involving a change of multiplicity do not produce strong band systems, and hence the only probable transitions are $^5\Sigma \rightarrow {}^5\Sigma$ and $^5\Pi \rightarrow {}^5\Sigma$. The bands in the yellow-green and blue, as seen on our spectrogram taken in the first order of a 20 ft. concave grating, appear to be too complicated for the first alternative, and the presence of branches of Q form favours a $^5\Pi \rightarrow {}^5\Sigma$ transition.

The lowest four terms of the Mn atom (excluding the ground state) are ^6D, ^8P, ^6P and ^6P. The ^6D term could produce a $^5\Pi$ level for MnH, but since the change to the ground level requires that a $3d$ electron should be promoted to the $4s$ shell, this change seems improbable. Both the ^6P terms could, however, give $^5\Pi$ levels, and it seems likely that this is the case, one producing the system of bands in the yellow-green, and the other the blue band.

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[1] *Proc. Roy. Soc.*, A, **148**, 312 (1935).
[2] *Naturwiss*, **24**, 521 (Aug., 1936).

Spectrum of Mercury Chloride (HgCl) and Samuel's Theory of Linkage

According to Samuel and co-workers[1], atoms of the second group of the Periodic System are chemically inert in their helium-like ground term ^1S. Linkage becomes possible only in an excited atomic term. Among many diatomic molecules (oxides and chlorides) of this group, cadmium fluoride (CdF), from its emission bands[2], is claimed to be a very conclusive example of this kind of linkage. Other investigations on the spectra of the diatomic halides of mercury, cadmium and zinc[3,4], however, make it probable that the ground state of these molecules is built up from unexcited atoms.

On this point, I would refer to a hitherto not analysed spectrum of diatomic mercurous chloride (HgCl) vapour, stretching from λ 5600 A. to λ 3200 A. This well-known spectrum, if excited in a Geissler discharge, consists of an enormous confusion of bands and is, therefore, unsuitable for analysis. If excited by fluorescence, however, that is, by optical dissociation of triatomic mercuric chloride ($HgCl_2$) vapour with light shorter than λ 1900 A., the spectrum shows a much simpler band structure. Almost all the bands (more than a hundred in number) which appear in fluorescence and are degraded towards the red, fit very well into the following vibrational equation:

$$\text{I.}\quad \left.\begin{matrix} v' = 0, 1, \ldots 33 \\ v'' = 0, 1, \ldots 11 \end{matrix}\right\} \quad \nu = 23372 + (191{\cdot}5\ v' - 0{\cdot}50\ v'^2) - (291{\cdot}9\ v'' - 1{\cdot}875\ v''^2) \quad \Big\} \text{I}$$

$$\text{II.}\quad \left.\begin{matrix} v' = 33,34,\ldots 50 \\ v'' = 11,12,\ldots 25 \end{matrix}\right\} \quad \nu = 23372 + (181{\cdot}75\ v' - 0{\cdot}35\ v'^2 + 159) - (301{\cdot}85\ v'' - 2{\cdot}35\ v''^2 + 52) \quad \Big\} \text{II}$$

The lower electronic state (v'') is identical with the ground state known from an ultra-violet band system of HgCl[4]. A rather sudden change of the anharmonicity occurring at high quantum numbers (at $v' = 33$ and at $v'' = 11$)—also observed in the band spectra of oxygen[5] and of chlorine[6]—makes it preferable to use two quadratic formula instead of a single cubic one. Formula I will be used for the

evaluation of the zero band ν_0 and of the ground frequency; formula II for the calculation of the dissociation energies D' and D''. Thus we obtain (in electron volts):

$\nu_0 = 2{\cdot}88$ volts, $D' = 2{\cdot}91$ volts, $D'' = 1{\cdot}20$ volts,

and, from that, the atomic term $\nu_a = \nu_0 + D' - D'' = 4{\cdot}6$ volts, a value equal to the term difference $2^3P_0 - 1^1S$ (4·65 volts) of the mercury atom. This remarkable agreement supports strongly the assumption that the ground state of the HgCl molecule is built up from a Hg atom in its lowest term (1^1S)—and not from an excited one—and from a Cl atom also in its normal term. The same will presumably hold for the other diatomic iodides, bromides and chlorides of mercury, cadmium and zinc, the spectra of which are very similar to the spectrum of HgCl. Further work is needed to confirm that and to ascertain whether the fluorides of these metals behave in a different manner.

Experiments on the spectra of HgBr and HgI are in progress.

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[1] *Phil. Mag.*, **21**, 41 (1936). NATURE, **138**, 411 (1936).
[2] Asundi, Samuel and Zakki-Uddin, *Proc. Phys. Soc.*, **47**, 235 (1935).
[3] Sponer, *Z. phys. Chem.*, B, **11**, 425 (1931). Oeser, *Z. Phys.*, **95**, 699 (1935).
[4] Wieland, *Z. Phys.*, **76**, 801 (1932) and **77**, 157 (1932).
[5] Birge, *Trans. Faraday Soc.*, **25**, 707 (1929).
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Gold Deuteride Bands

AN arc between gold poles in heavy hydrogen gas of high concentration at a pressure of about 12 cm. mercury was photographed in the second order of a 15-ft. concave grating. 723 AuD lines lying between λ 3370 A. and λ 4440 A. were analysed into eleven bands of a $^1\Sigma \rightarrow {}^1\Sigma$ system as, $2 \rightarrow 0$ (λ 3382), $1 \rightarrow 0$ (3502), $2 \rightarrow 1$ (3585), $0 \rightarrow 0$ (3646), $2 \rightarrow 2$ (3775), $0 \rightarrow 1$ (3872), $1 \rightarrow 2$ (3935), $2 \rightarrow 3$ (4005), $0 \rightarrow 2$ (4117), $1 \rightarrow 3$ (4183) and $0 \rightarrow 3$ (4384) vibrational transitions. The $1 \rightarrow 1$ band was of such low intensity that no single line of it could be identified.

Preliminary evaluation of molecular constants, based on the rotational energy function ending in the $J^2(J+1)^2$ term for both the $^1\Sigma$ states, and adjusted for the region of $J = 6 \sim 10$ to $J = 30 \sim 35$ in each vibrational level, has yielded the values given in the accompanying table, with calculated probable errors for the rotational constants.

MOLECULAR CONSTANTS OF AuD

	Lower $^1\Sigma$ state	Upper $^1\Sigma$ state
T_e	0	27644·1
ω_e	1634·98	1195·24
$x_e\omega_e$	21·66	34·81
$y_e\omega_e$	−0·0288	—
B_e	3·6413 ± 0·00008	3·041 ± 0·003
a	0·07608 ± 0·00002	0·1075 ± 0·001
D_e	$-0{\cdot}7090 \times 10^{-4} \pm 0{\cdot}0002 \times 10^{-4}$	$-0{\cdot}79 \times 10^{-4} \pm 0{\cdot}01 \times 10^{-4}$
β	$3{\cdot}36 \times 10^{-7} \pm 0{\cdot}04 \times 10^{-7}$	$-6{\cdot}2 \times 10^{-6} \pm 0{\cdot}4 \times 10^{-6}$

D_v of the upper $^1\Sigma$ state *decreases* with v in a markedly non-linear way, but as only three vibrational levels are found in this state, the most probable values of D_e' and β' for the linear formula are provisionally given in the table.

The electronic isotope shift from the corresponding AuH system ($0 \rightarrow 0$, λ 3650 A.) is + 14 cm.$^{-1}$. Other isotope relations between the constants of the two molecules will be considered in a coming number of the Institute's publication (*S.P.I.P.C.R.*), together with frequency tables and other details of the observed deuteride bands.

SUNAO IMANISHI.

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Jan. 30.

Correlation of Ionization Constants of Organic Acids with Dipole Moments

SINCE ionization constants and dipole moments are both measures of polarity, it is logical to suppose that a connexion will exist between them. Interesting results have followed an examination of the elementary possibility that the difference between the strengths of substituted and unsubstituted acids in the benzoic and phenylacetic series, and the dipole moments of monosubstituted benzenes (virtually the substituent groups), are simply related. The ionization constant values (K_{therm}) were all derived in this Department and the dipole moments were those employed by Dippy and Watson[1] in connexion with the logarithmic relationship observed previously. These sets of data possess the advantage of being comparable.

In the benzoic series the points representing *m*-nitro-, *m*-methoxy-, unsubstituted and *p*-methyl-substituted acids are distinctly colinear. A second straight line of much smaller angle can also be drawn through *m*-nitro-, *m*-chloro, *m*-iodo-, unsubstituted and *p*-methyl phenylacetic acids. In the benzoic acids the *m*-halogens show a small disparity (cf. Dippy and Watson[1]) but the abnormality has been so diminished in the phenylacetic acids that it is not distinguishable. The inclusion of the *p*-methyl acids, and not the *m*-acids, as at first expected, is especially important, and it must mean that the polar effect of the methyl group measured in toluene, is the effect of a *p*-methyl substituent, that is, the two permanent components (the inductive and mesomeric effects) are operative.

A fuller account of this relationship, accompanied by figures, will be published shortly.

J. F. J. DIPPY.

Technical College,
Cardiff. Feb. 24.

J. Chem. Soc., 436 (1936).

Electron Inertia as the Cause of Harmonics in Valves

THE Lagrangian form[1] of Benham's equation[2], connecting the total current density with the rate of change of acceleration of particles of charge e, mass m, moving in a one-dimensional, non-uniform* electric field, may be written, for electrons,

$$\dddot{x} = 2{\cdot}00_2 \times 10^{28}\bar{\imath} \quad . \quad . \quad . \quad . \quad (1)$$

in which the numerical value of $\frac{4}{10}\pi\frac{e}{m}c^2$ is in dynes coulomb^{-1} gm.$^{-1}$ and $\bar{\imath}$ is in amp. cm.$^{-2}$. The electric field, which may vary with time in any manner, is proportional to $\ddot{x}$. Omitting the constant, and writing $q = \int\bar{\imath}dt$, we obtain from (1), on integration over the interval $(t - t_0)$:

$$\ddot{x} = \ddot{x}_0 + q(t) - q(t_0) \quad . \quad . \quad . \quad . \quad (2)$$

* The non-uniformity is caused only by the electrons themselves.

By differentiating equation (2) with respect to time at x constant, we find :

$$\left.\frac{\partial \ddot{x}}{\partial t}\right|_x = \left.\frac{\partial \ddot{x}_0}{\partial t}\right|_x + \bar{\imath}(t) - \bar{\imath}(t_0)\left.\frac{\partial t_0}{\partial t}\right|_x$$

$$= \left[\frac{\partial \ddot{x}_0}{\partial t_0} - \bar{\imath}(t_0)\right]\frac{\partial t_0}{\partial t} + \bar{\imath}(t) \quad . \quad . \quad . \quad (3)$$

Equation (3) shows that the quantity $\bar{\imath}(t) - \frac{\partial \ddot{x}}{\partial t}$ is related to its value at the plane $x = 0$ $(t - t_0)$ seconds earlier by the relation

$$i_c(x,t) = i_c(0,t_0)\left.\frac{\partial t_0}{\partial t}\right|_x , \quad . \quad . \quad . \quad . \quad . \quad (4)$$

(where $i_c(x,t)$ has been written for the quantity $\bar{\imath}(t) - \frac{\partial \ddot{x}}{\partial t}$, and clearly represents the electron convection current. If we perform three integrations of equation (1), we obtain the position x of a particle which started with a velocity $\dot{x}_0$ and acceleration $\ddot{x}_0$ at instant t_0 and travelled over the distance x in the interval $(t - t_0)$. This expression may then be differentiated with respect to t, keeping x constant. For a total current of the general form $\sum_{n=o}^{n=\infty} \bar{\imath}_n e^{npt}0$, (where p may be complex in general), the value of the electron convection current ratio $\left.\frac{\partial t_0}{\partial t}\right|_x$ is then found to be as follows (5):)

$$\dot{x}_0 + \ddot{x}_0(t-t_0) + \sum_{n=0}^{n=\infty} \frac{\bar{\imath}n}{(np)^2}\left\{ e^{npt} - e^{npt_0} - np(t-t_0)\,e^{npt_0} \right\}$$

$$\dot{x}_0 + \ddot{x}_0(t-t_0) - (t-t_0)\left.\frac{\partial \dot{x}_0}{\partial t_0}\right| + \tfrac{1}{2}(t-t_0)^2\left\{\sum_{n=0}^{n=\infty} \bar{\imath}_n e^{npt_0} - \frac{\partial \ddot{x}_0}{\partial t_0}\right\}$$

The term $\left\{\sum_{n=0}^{n=\infty} \bar{\imath}_n e^{npt_0} - \frac{\partial \ddot{x}_0}{\partial t_0}\right\}$ represents in all circumstances the electron convection current $i_c(0,t_0)$. In the space charge limited diode, the terms in $\dot{x}_0, \ddot{x}_0$ may be omitted without great error from the expression (5), provided the total transit time is not less than 4×10^{-10} seconds for a total current density of 100 in mA.cm.$^{-2}$. Then

$$i_c(x,t) = \sum_{n=0}^{n=\infty} \bar{\imath}_n . \Upsilon_3(n\alpha) . e^{npt}, \quad . \quad . \quad . \quad (6)$$

where $\Upsilon_3(\zeta) = \frac{2}{\zeta^2}\left\{1 - e^{-\zeta} - \zeta e^{-\zeta}\right\}$ and $\alpha = p(t-t_0)$.

In order to see the significance of this result, let us suppose the total current to consist of zero and first order terms only. Then equation (6) reduces to

$$i_c(x,t) = \bar{\imath}_0 + \underrightarrow{\bar{\imath}_1 \Upsilon_3(\alpha) e^{pt}} \quad . \quad . \quad . \quad . \quad (6a)$$

The arrow means that the term in question is not a pure sinesoid in view of variations in the value of $\frac{\alpha}{p}$ $(= t - t_0)$ about a mean value. Higher harmonics are thus contributed by the underlined term. The fundamental is obtained by writing $\alpha = \alpha_0$ in (6a), which gives the usual solution without reference to the ripple α_1. Similarly, the second order term is obtainable without reference to the ripple α_2 but requires the ripple α_1 to be known in addition to α_0.

Thus, not only has a considerable simplification been introduced into the calculation of the fundamental component, but also, by the present analysis, the calculation of second, third and even fourth harmonics of potential is made possible[3]. I have completed the accurate calculation of the second harmonic in the space charge and emission limited plane diodes, and I hope to make these available in the near future.

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[1] *Wireless Engineer*, **8**, 96, 489, equation 5 (1931).
[2] *Phil. Mag.*, **2**, 462, equation 5 (1931).
[3] See *Wireless Engineer*, **13**, **155** (August 1936), for the relation between i_c and v in the case $n = 1$.

Phosphorescence of the Sea

The well-authenticated phenomenon of streaks of phosphorescent water appearing in the sea[1] is doubtless due, in some way or other, to the agitation of phosphorescent marine organisms. In the past it has been ascribed, either to the effect of long rollers[2] or less commonly to porpoises[3] or schoals of fish below the surface[4].

W. Schmidt's[5] observations on the so-called 'oil-patches' on water surfaces suggest a new interpretation. Under the influence of wind, a water surface divides itself up into ascending and descending areas, in the latter of which all small floating bodies collect. In lakes the descending areas often take the shape of long streaks, although there is no reason why other forms should not occur in the open sea.

If, therefore, luminous organisms collect in the descending areas, streaks of light might occasionally be formed. That the observed lines of phosphorescent water are at least occasionally formed in this way seems to follow from the fact that they have sometimes been observed to coincide with areas in which the water is especially calm. Thus L. C. Higgins[6] (South Atlantic. July 5, 1926) reported five bands stretching across the water "as far as eye could see" and added : "The phosphorescence seemed to make the sea thick and sluggish." Similarly, H. A. Standfeld[7] (China Sea, April 24, 1928) reported six streaks and remarked : "It was also noticed that the streak had an oily appearance on the surface of the water."

A similar interpretation is probably to be placed on the large patches of luminous water covering a few hundred square yards which have been recorded repeatedly. In a recent description by W. J. V. Branch[8], they have been stated to exert a calming effect comparable with that of light oils on water.

If this interpretation should be confirmed, observations on the shapes and sizes of phosphorescent marine areas should serve to throw light on the vertical movements of sea water.

R. E. D. Clark.

St. John's College,
Cambridge.
Feb. 22.

[1] Smith, H. T., *Marine Observer*, **8**, 230 (1931).
[2] Nature, **138**, 278 (1936).
[3] *Marine Observer*, **6**, 171 (1929) ; **9**, 130 (1932).
[4] *Marine Observer*, **8**, 79 (1931).
[5] Nature, **137**, 777 (1936).
[6] *Marine Observer*, **4**, 126 (1927).
[7] *Marine Observer*, **6**, 75 (1929).
[8] *Marine Observer*, **13**, 47 (1936).

Occurrence of *Eucrangonyx gracilis*

IN NATURE of February 20, there appeared an interesting letter from Mr. G. I. Crawford recording the amphipod, *Eucrangonyx gracilis*, from the filter beds of the Metropolitan Water Board at the Lea Bridge Works.

It may be of interest to record that some years ago I received from Dr. Robert Gurney, of Oxford, an amphipod which was found in a glass of water drawn from the domestic supply of a house in Hackney. The only species with which I could identify the specimen was *Eucrangonyx gracilis*, but the occurrence appeared to me to be so unusual and puzzling that I refrained from recording the species pending confirmatory evidence in the shape of more material. It was impossible to trace the householder who found the specimen originally and it seemed possible, though not very probable, that the specimen may have had an entirely different provenance. Mr. Crawford's letter solves all my difficulties, and it is very satisfactory to have the little mystery cleared up. The specimen which I examined was undoubtedly *E. gracilis*, and its provenance the water supply of the Metropolitan Water Board.

W. M. TATTERSALL.

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March 11.

Points from Foregoing Letters

A DESCRIPTION of the spectra of 'northern lights', both red and the 'sun-lit', usually feeble, grey-violet auroras, simultaneously photographed from several Norwegian stations, is supplied by Prof. Carl Störmer. The height of the red auroras was mainly between 100 km. and 500 km., whilst some of the 'sun-lit' auroras had their summit above 800 km. and in one case reached 1,100 km. above sea-level.

Photographs showing patterns obtained by means of a Fabry-Perot interferometer with radiation scattered by phenol, butyl alcohol and acetone are submitted by Sir C. V. Raman and B. V. Raghavendra Rao. The pattern given by phenol is indistinguishable from that of the incident radiation and indicates, according to the authors, that in such highly viscous liquids the sound waves of high frequency necessary for reflecting the incident light are absent, while in the more fluid acetone the greater intensity of the components shifted by the Doppler effect indicate the existence of organized sound waves, as part of the thermal agitation.

Referring to the history of the thermometer, Dr. Kirstine Meyer quotes from Rømer's "Adversaria" to show that he used, as lower fixed point (7½° on his scale), the melting point of snow or crushed ice, and not a freezing mixture of ice and salt. Dr. Newton Friend agrees that Rømer used melting ice as control for his point at 7½°, but considers that his original scale must have been based upon the temperature given by ice and salt or ice and sal ammoniac, which closely agrees with the zero point on Rømer's scale.

Curves showing the changes in the absorption spectrum of a solution of visual purple after exposure to light, and afterwards on standing, are submitted by Dr. G. Wald. These, he considers, show the common belief, that the orange colour brought about exposure to light is due to a mixture of unbleached visual purple and final yellow product, to be mistaken. The orange colour, he states, is itself a new pigment which fades to yellow retinene in complete darkness.

Dr. N. Hamilton Fairley reports in the plasma of severe cases of blackwater fever a new pigment which hitherto has been mistaken for methæmoglobin. The pigment has never been found within the corpuscle, fails to appear in the urine, and by its spectrogram and a number of chemical reactions is readily differentiated from methæmoglobin. It may be readily produced *in vitro* by incubating a solution of oxyhæmoglobin and plasma for 48 hours at 37°–40° C. Pseudo-methæmoglobin is suggested as an appropriate name for the new pigment.

The effect of testosterone propionate in inducing mating behaviour in young rats which had been castrated when young (before the beginning of sexual behaviour) are described by Dr. H. A. Shapiro.

When living cells are injured or killed by ultra-violet light, they produce substances which stimulate respiration, etc., according to experiments by J. C. Fardon, R. J. Norris, Prof. J. R. Loofbourow and Sister M. V. Ruddy. From irradiated yeast, also from liver, kidney and embryo tissue active substances were obtained which could pass through a filter or dialysing membrane. Different orders of potency with regard to stimulation of respiration, proliferation and fermentation were observed, which suggests the existence of at least three substances responsible for the effects.

Experiments described by L. Shubnikov and I. Nadhutin show that a single spherical crystal of tin in the 'intermediate' supraconducting state (when the magnetic permeability is no longer equal to zero) possesses anisotropic supraconductivity. When the direction of the current is parallel to the external field, the sphere remains supraconductive even when the magnetic permeability is near unity; in the direction perpendicular to the field, supraconductivity vanishes at field strength $2/3\ H_k$.

Bands in the red, yellow-green, green and blue have been obtained by Dr. R. W. B. Pearse and A. G. Gaydon in the spectrum of an electric discharge between manganese poles in a hydrogen flame. These bands are attributed to manganese hydride, MnH. The nature of the electronic transitions are discussed in relation to the levels of the manganese atom.

The analysis of a band spectrum of mercurous chloride (HgCl) vapour, in Dr. K. Wieland's opinion, supports the view that the ground state of this molecule is built up from unexcited atoms. This does not agree with results from the spectrum of CdF obtained by Samuel and his co-workers, who suggest that the ground state of CdF, like that of all diatomic oxides and halides of the second group, is formed from a metal atom in an excited term only.

The molecular constants of gold deuteride have been calculated by S. Imanishi from the arc spectrum obtained between gold electrodes in heavy hydrogen gas.

W. E. Benham gives a simple electronic analysis yielding the electron convection current for any periodic total current waveform. The solution is in terms of the instantaneous electron transit time, and permits calculation of the nth harmonic in a valve if the transit time is known to the $(n-1)$th order only.

Research Items

Religious Beliefs of Serbian Gypsies

Dr. Alexander Petrovič, in continuation of his studies of the Serbian gypsies (*J. Gypsy Lore Soc.*, Ser. 3, **16**, 1–2) deals with religion and superstitions. The Serbian gypsies, who speak the Romani language, can be divided into two groups of a higher and lower culture. The first are permanent city-dwellers, while the latter have no permanent place of habitation. The former have adopted the religions and customs of other people, but with a difference. The beliefs of the second class appear to preserve some of the elements of the ancient gypsy religion. *Del* is God, the sky or heaven, or the clouds. *Del* is the unlimited space above the earth, and sends rain, snow, hail. Once *Del* was close to the earth. This was when life was good to live, and everything came easily. But *Del* was offended and moved away. *Dji* is the stomach or abdomen, and also the soul. If asked where the soul is situated, a gypsy will point to his navel; but if a physical condition of the stomach has to be described, they use *por*. *Dji* is also the heart. In Bela Crkva gypsy musicians use one word *odji* for both heart and soul. *Dji* is the centre of everything, the most precious part of anything, and also the breath of one's being. When a man dies "the soul (*dji*) escapes hence by the mouth". Coano "vampire", "ghost", is the word used also for the soul that goes out of the mouth when a man dies. As soon as a body was placed in the grave, the mourners used to throw earth on it and run away, and no one looked back, because the ghost would think he was being called and follow. The spirit of evil is *Beng*, who appears incarnate immediately his name is mentioned. The gypsies do not know if Good exists in the world, but they are sure that Evil does. *Kar*, "man", "male", and the male organ of generation brings luck. It is the creative and active principle. *Kar* is used in oaths instead of "God". In looking at their religion as a whole it must be emphasized that they are realists, and believe in what can be seen, for example, the identification of God and sky. *Del* gives but does not create. The creative principle is *kar*.

Kutchin Potlatch

Dr. Cornelius Osgood has attempted, as part of a study which will cover eventually the northern Athapascan area as a whole, a reconstruction of the culture, as it was about one hundred years ago, of the Kutchin, or rather of the several tribes known by that name, who inhabit the country from the region around the great bend of the Yukon River, eastwards into the valley of the Mackenzie, north to the littoral of the Arctic Ocean held by the Eskimo, and south to roughly lat. 65° north (*Yale Publications in Ethnology*, No. 14). His observations include an account of the potlatch, of which the performance was most fully celebrated among the Crow River Kutchin. It was given in honour of a person deceased, but at no other time or occasion. The donor, a relative, accumulated food and property for the purpose during the period of mourning. A period of one to two years might elapse, and the size of the potlatch would depend upon the wealth and influence of the persons involved, as well as on whether it was a time of plenty or scarcity. The primary purpose seems to have been the enhancement of family or personal prestige, as well as, in the background, the idea of reciprocity. The potlatch was generally held in a special ceremonial ground or enclosure. The fence served the purpose of apportioning the gifts, skins and so on, which were set out there on display. The duration of the potlatch correlated directly with the elaborateness of the display and the time required to consume all the food prepared. In a small potlatch, only the local population participated. In the larger, other tribes were invited to attend. Important or distant guests were formally escorted to a suitable reception, watch for their approach being kept night and day for some time. On arrival, the leader of each group made a suitable speech, and a welcoming reply was made. Dancing was a common activity during the ceremony. Speeches were made at intervals, and games and tricks played. The final act was the distribution of gifts, performed by a friend of the giver who was paid for his service.

Impaction of Man's Third Molar Teeth

Mr. Bowdler Henry and Dr. G. M. Morant give an account of a preliminary examination they have made of skiagrams showing man's wisdom teeth in the process of eruption (*Biometrika*, 378, Dec. 1936). As is well known, eruption of a tooth involves an elaborate series of growth movements not only in the tissues which surround a cutting tooth, but also in parts of the bony tissues at a distance. The growth movements which bring up the third molars—man's wisdom teeth—are particularly complicated, and are very apt to be delayed or arrested, particularly in western Europeans. The teeth most liable to arrest are the lower molars. The impaction of these may give rise to disorders so serious as to threaten the life of a sufferer. It would be a great advantage if a dental surgeon could tell, from the examination of dental skiagrams of young people, whether or not their wisdom teeth were likely to become impacted. Mr. Bowdler Henry has proposed certain methods, based on the examination of 622 skiagrams. His results have been examined statistically by Dr. G. M. Morant. They have determined to extend the investigation, but meantime certain hints are given which are likely to have a practical value for dental surgeons.

Sponges of the Panama Canal

Dr. M. W. de Laubenfels has recently compared collections of shallow-water, and mainly intertidal sponges, made by him at either end of the Panama Canal, during the summer of 1933 (*Proc. U.S. Nat. Mus.*, 83, No. 2993; 1936). Among a total of 31 species collected, 10 are restricted to the Pacific side, 15 to the Atlantic side, 6 being recorded from both sides. New species are described in the respective proportions of 4 to 16 on the Pacific side, and 6 to 21 on the Atlantic side; not as 5 and 7 respectively, as stated, apparently in error. With the exception of

four strictly keratose species, including two Hircinіæ, from the Atlantic side, and one, *Aplysilla*, from the Pacific, all are siliceous species, the Calcarea not being represented.

The Teak Borer of Burma

THROUGHOUT the main teak-bearing areas of Burma, the timber suffers from the beehole or gallery caused by the larva of a large moth, *Xyleutes ceramica*. This insect is a member of the primitive family Cossidæ to which the familiar goat moth (*Cossus cossus*) of Britain and other European countries belongs. A survey of the injuries caused by the beehole borer has recently been made by Mr. D. J. Atkinson, forest entomologist for Burma. His account forms No. 1 of vol. 2 of *Indian Forest Records* (N.S.), Entomology (1936) wherein data are given for the mean incidence of the borer as affecting 1,001 trees taken from 56 localities. Average rainfall is a sound index of the probable severity of the damage: below the isohyet of 55 in., conditions become less favourable to the insect. It was also found that much of the naturally grown teak timber in Burma is more heavily infested than a great deal of the plantation timber. The faster growth of the latter operates to advantage, and serves also to accentuate the natural tendency for an increase in beehole borer damage towards the centre of the tree, and the faster the growth of the tree the greater the volume of comparatively borer-free timber which will be produced. Where conditions are suitable, heavy and repeated thinnings to encourage the volume increment, to outstrip the borer increment, are advised.

Storage of Pollen

THE possibility of storing pollen from one year to another has distinct advantages in horticultural practice. Hitherto, although methods have been devised for transplanting pollen over considerable distances, the maximum viability has not extended beyond the current season. B. R. Nebel and M. L. Ruttle (*J. Pom. and Hort. Sci.*, 14 (4), 347; 1937) have succeeded in keeping pollen of apple and sour cherry in store for more than two years, and their data indicate that similar longevity may be attained by pollen from pear, plum, sweet cherry and grape. The latter species have been stored for more than a year, but the experiments are as yet incomplete. The period of life of apple and sour cherry pollen stored at 2°–8° C. increases with decreasing humidity from 100 per cent to 50 per cent, the latter being the optimum. Apple pollen which had apparently lost its viability after being stored in the laboratory for five weeks was revived by storing at 2°–8° C. and 80 per cent humidity. Pollen from several common varieties of the species mentioned was used, and the success of the experiments should enable plant breeders to make crosses between varieties which flower in different seasons or are separated geographically.

Effect of Oxidizing Agents on Crop Production

PROF. V. SUBRAHMANYAN, C. R. Harihara Iyer and R. Rajagopalan, of the Indian Institute of Science, Bangalore, in a communication to the Editor, have directed attention to the possibilities of increasing crop production through judicious applications of chemical oxidizers, and have outlined the attendant chemical and biological changes. All crops showed increase in yield on both unmanured and manured soils. The oxidizing agents differed in efficiency, potassium permanganate usually being more active than either hydrogen peroxide or ferric oxide. Permanganate gave the best results when applied as a basal dressing, while manganese dioxide was most efficient as a top dressing. The crops also varied in their response to different oxidizers. Ammonia production in the soil was increased, and the oxidation of organic matter facilitated, but the biological changes consequent on the application of oxidizers were not pronounced. With permanganate there was an initial depression in the number of bacteria followed by a rapid rise after the fourth day. Soluble manganese salts applied to soil pass into an insoluble form and oxidation of organic matter occurs with the production of carbon dioxide, particularly on non-sterile soils. There is some evidence that biological activity is stimulated, resulting in greater production of carbon dioxide and increased plant assimilation. Manganese dioxide and permanganate gave the best results, manganous sulphate following next in order, while manganous carbonate was not much superior to untreated control. Pretreatment with lime was found to depress the yield, at any rate in the case of the eight varieties of tomatoes that were tried. In none of the cases was there any evidence of increased intake of manganese. The foregoing and other observations would suggest that although certain inorganic compounds may produce profound physiological effects in culture solutions, through purely ionic action, they act in a different way in the soil, this being particularly true of manganese salts, which are rendered insoluble in the soil.

The Structure of a Cellulose Wall

THE *Valonia* cell wall, of which a model is figured by Drs. R. D. Preston and W. T. Astbury in a recent paper (*Proc. Roy. Soc.*, B, 122, No. 826, March 3, 1937) must have been submitted to far more intensive study than the cell wall of any other individual cell. As a result, a most interesting and complicated structure is revealed. The cellulose chains in one of these layers form a system of meridians in the wall running from the base to the apex of the cell, and the chains of the alternate layers build a system of spirals closing down on the two 'poles' defined by the meridians. The X-ray photographs confirm the fibrillar structure suggested by the microscope, and it is now clear that the *Valonia* wall is built of alternating layers of differently orientated cellulose fibrils which cross each other at an angle of a little less than 90°. The major extinction position shown by the polarizing microscope bisects this angle approximately, though its position varies with the varying proportion of the two types of lamellæ. It is abundantly clear that the direction of the cellulose chains in a cell wall cannot be reliably determined by observations with a polarizing microscope alone. The authors discuss the involved problems presented by the deposition of such a wall by the growing cell. There seems no doubt that the patchwork appearance indicated in surface view on examination by the polarizing microscope is the result of the cracking of the outer layers by the continued volume expansion of the growing cell, but it is difficult to visualize a mechanism which should lead to the successive deposition of layers with cellulose chains crossing at an angle of nearly 90°.

The Aluminizing of Telescope Mirrors

On *Leaflet* No. 96 issued by the Astronomical Society of the Pacific, Dr. J. Strong of the California Institute of Technology, contributes a short article on "What Aluminium has done for the Reflecting Telescope". An account both of the history of the coating of mirror surfaces with aluminium and other metals by an evaporation process, and of the promising astronomical results obtained with reflectors that had been aluminized, has already been given in Nature (134, 522; 1934). The chief advantages of using aluminized mirrors in telescopes are: (1) the high degree of reflectivity and freedom from scattered light maintained over a considerable period of time, as compared with the life of a silvered surface; (2) the high reflectivity in the violet end of the spectrum where a silvered surface absorbs strongly. Thus, aluminium reflects 87 per cent of the incident light below wave-length 4100 A., whereas the reflectivity of a freshly silvered surface rapidly diminishes from 90 per cent at λ4100 to only 4 per cent at λ3150. Consequently, with an aluminized optical train, it is possible to photograph stellar spectra down to the limit of transmission of the earth's atmosphere at about λ3000. This latter property has enabled Wright at the Lick Observatory to discover new emission lines in the spectra of planetary nebulæ, while Duncan has found the existence of an outer envelope to the well-known ring nebula in Lyra. Another illustration of the value of aluminized surfaces is the fact that after the mirrors of the 60-inch and 100-inch reflectors on Mount Wilson had been aluminized, it was found that the resulting gain at the Cassegrain focus (involving reflections at three surfaces) was equivalent to one photographic magnitude, or about the increase in light grasp of the 100-inch as compared with that of the 60-inch. Although in the process of aluminizing smaller mirrors difficulties are sometimes encountered, Dr. Strong thinks that no unusual problem will be presented in aluminizing the 200-inch mirror when it is ready; the 36-inch Crossley reflector at the Lick Observatory and the two great telescopes at Mount Wilson have already been successfully treated.

Electricity in Mining

To the *Journal of the Institution of Electrical Engineers* of February, Prof. W. M. Thornton contributes an interesting review of the progress made in the use of electricity in mining during last year. A recent figure for the number of electric units consumed per ton of coal raised is 25. This includes the heavy pumping demands. In Northumberland and Durham alone, it has been estimated that 125 million tons of water are raised annually. This is enough to form a lake of 25 square miles in area and 6 feet deep. Underground haulage, for which an electrical drive is admirably suited, takes nearly as much power as pumping. But there are still 40,000 ponies employed in Great Britain on underground haulage. This may be compared with 64,000 ten years ago. Considerable improvements in the design of ventilating fans for collieries have recently been made, embodying the most recent theories of air screws. A 300-h.p. fan, in use at Dodworth colliery, has an 89 per cent efficiency—a remarkable performance. The flame safety lamp in its early days showed the presence of high proportions of firedamp by the gauze becoming red hot. In capable and trained hands it proved on the whole a trustworthy guide to the percentage of firedamp in the mine. But it cannot, in unskilled hands, be used to detect the safety limits of $1\frac{1}{4}$ or even $2\frac{1}{2}$ per cent. Two forms of electric safety lamp have recently been fitted with a means of rapidly detecting 1–4 per cent of firedamp. One of these, the Gray 4-volt acid lamp, is coming into use, and is approved by the Mines Department. An interesting development is the electrostatic precipitation by the Lodge method of the finely divided tar fog in coal or coke-oven gas. Two 15,000 volt d.c. generators are mounted on insulators and connected in series. The negative terminal is connected to a wire grid and the positive to plates. On the application of the field, the fog becomes charged negatively, deposits on the positive plates, and falls. In one such plant about 6·5 million cubic feet are treated daily, and practically every trace of fog is removed. The currents used vary between one twentieth and one half an ampere.

Synthesis of Fluorene Compounds

Further contributions to the study of diphenyl and its derivatives have been published by Prof. L. Mascarelli and his co-workers (*Atti Accad. Sci. Torino*, **72**, 64 and 109; 1937). Of special interest is the behaviour of 2-4′-dimethyl-2′-aminodiphenyl, the preparation of which is described. When this substance is diazotized and the product boiled with water, an almost theoretical yield of 2-methylfluorene is obtained. This reaction provides a second example of the direct synthesis of a fluorene ring compound from a diphenyl derivative, which was discovered by Mascarelli in 1932. The trisubstituted diphenyl compound 2-6′-dimethyl-2′-aminodiphenyl, when subjected to a similar treatment, gives only a small yield of 4-methylfluorene. With a tetrasubstituted diphenyl derivative, no fluorene ring synthesis occurs. The subject is further discussed in a paper by Prof. Mascarelli (*Gazzetta Chimica Italiana*, **66**, 843; 1936).

Colour Variation in the Equatorial Belts of Jupiter

Mr. A. Stanley Williams, a very assiduous observer of the planet Jupiter, contributes an interesting paper on this subject to *Mon. Not. Roy. Astro. Soc.*, **97**, 2 (Dec. 1936) which deals with his observations from 1930 to the end of last year. His first paper on the subject, published in 1899, showed that the observations up to that date indicated a period of 12·08 years in the variation, and his second paper in 1930 gave a period of 12·5 years. The results of the last six years' work show that the period must be shortened to 11·86 years, the period of the revolution of the planet around the sun. The adopted elements of variation are: Standard epoch = 1838·52 + 11·86 E years. At the time of a standard epoch the North Equatorial Belt is at or near a minimum of redness, while the South Equatorial Belt is at or near a maximum. At intermediate epochs the colours of the belts are reversed from those just mentioned. As the computed date of the next standard epoch is 1945·2, when the North Equatorial Belt will be at or near a minimum of redness, and the South Equatorial Belt at or near a maximum, observations during 1945 and a year or two before and after are highly desirable.

The New Forest*

ORIGINALLY an old Crown forest, and nowadays the most extensive of these remnants of the old Royal forests, the New Forest, in Hampshire, comprises some 90,000 acres and is under the management of the Forestry Commissioners. The Forest comes under the designation of a true forest, though large areas consist of open heath-land subject to rights of grazing and so forth ; these limit planting and other forestry operations which would constitute the area a commercial proposition. Perhaps no other area of the type has received so much attention from Parliament, and numerous Acts have been passed for the administration of the law relating to it. The Acts of 1877 and 1879 may be said practically to have settled the Government policy *vis-à-vis* the forest, which is now regarded as a national playground; the coming of the motor-car having enormously extended the area from which visitors now resort to the Forest. These factors are rendering its management, even from the sole point of view of maintaining its beauty for future generations, a delicate and difficult task.

Apart from the Forestry Commission, several bodies such as the New Forest Association, the Court of Verderers, the Scapa Society, the Council for the Preservation of Rural England and the New Forestry Advisory Committee constitute what may perhaps be best expressed as vigilant committees over the maintenance of the Forest in its pristine beauty.

Some of the difficulties confronting the management are portrayed in the annual report for 1936 of the New Forest Association. The objects of the Association are given as follows : "The preservation of the general picturesque aspect of the Forest and the old woods and the protection of the rights and privileges of the Commoners and of the Public in the enjoyment of the Forest." From the professional forester's point of view, some of these objects are conflicting, so far as the public are concerned. To give one instance, the preservation of the picturesqueness of the old woods, for example, the Mark Ash inclosure of old beech, famous during the past half century amongst artists and other lovers of scenic beauty. How is this old wood to be perpetuated ? The wooded parts of the forest, the beautiful inclosures of old broad-leaved trees, present analogous cases.

The New Forest Association has its own problems. One of the first mentioned would be scarcely understood by European Continental nations, accustomed to regard forests as economic commercial propositions. The matter in question is the spread of seedling fir trees coming up from blown seed. The spread of these young trees is said to be continuing at an alarming rate ; with the obvious result that their growth in height will interfere with the beautiful views over the open forest, which it is one of the objects of the Association to maintain ; whilst it is said that the presence of the trees diminishes the grazing area. The attention of the Forestry Commission has been directed to this, one of Nature's own acts. It is a curious anomaly to find man fighting against Nature in her effort to provide him with produce free of cost ; whilst elsewhere in the country the Commission is spending pounds per acre planting the very same type of tree. The cost of continually removing these young trees would, it is said, be considerable.

If one of the objects is to maintain the grazing, should not such work be undertaken by the right holders who own the grazing ? The Association suggests a special grant being made by Government ; but it is difficult to see how the expenditure of the tax-payers' money on such an object could be justified.

The Association has saved the Forest from pylons, but with the praiseworthy aim of making electricity more commonly available, poles and overhead cables are on the increase. The report alludes to litter dumping and the refuse left by visitors, and rightly considers that education and persuasion, of the old as well as the young, are the chief means by which litter may be gradually decreased.

The New Forest ponies present a problem. Within the Forest boundaries they are on their own ground. But of late years they have taken to straying outside the boundaries. In the days before the motor-cars on the roads had reached their present numbers, there were gates on the roads leading into the Forest. The value of these latter, nowadays always left open, has disappeared. The 'grid', so commonly seen at the entrance to drives of private houses, was suggested, but the County Surveyor expressed his opinion that his Council would not be prepared to make the grids. So this problem remains unsettled. Oil prospecting in the Forest has raised a scare, but nothing definite has yet transpired, save the fact that the Association would raise the strongest objection to the desecration of the Forest by such operations.

All the inclosures in the Forest have gates, a field gate and a small hunting gate alongside. These are all left unlocked. The Association quite correctly urges on the public always to close the gates on passing through ; or the courtesy of the Forestry Commission in leaving the gates open may be withdrawn.

Probably the most important part of the report lies in the remarks on the condition of the Forest, and these remarks will receive support from many who, though non-resident, are well acquainted with the Forest. As the report puts it : "The Council have for many years past viewed, with great concern and alarm, the great deterioration in the condition of the open and enclosed spaces of the Forest to which the public have access. They interpret the New Forest Act 1877 as laying down that the amenity of the Forest is the object of management, and that any consideration of profit should take a second place." It may be mentioned that in many parts of the Continent of Europe it is regarded as quite feasible to secure both objects by a correct management without a loss of amenity. But the present condition of parts of the Forest is reducing amenity and its use by the public and is equally uneconomic. The most glaring item in this want of management is the neglect of draining over areas of varying size throughout the region—a neglect which cannot be laid to the door of the Forestry Commission ; for it is the aftermath of the want of efficient management in these matters of a century or more.

* New Forest Association. Annual Report and Statement of Accounts. Pp. 18+6 plates. (Brockenhurst : Capt. Cecil Sutton, Hon. Sec., The Estate Offices, 1936.)

Disease Resistance in Plants

VOL. 3, No. 6, of the *Proceedings of the Indian Academy of Sciences* is devoted entirely to the papers submitted for the symposium at Coimbatore in October 1935 on "Disease Resistance in Plants". Interest in the contributions lies in methods of stimulating disease resistance. These are adopted as a result of investigations along the lines of inheritance of resistance, structural modification associated with resistance and physiological conditions associated with the plants' response to the disease. Thus in the case of sugar-cane, frequently attacked by mosaic, N. L. Dutt, Syed Abbas Hussainy and M. K. Krishnaswami; C. S. Krishnaswami, and others, have found it possible to breed resistant plants and that those with *Saccharum spontaneum* parentage are more resistant than others.

Other workers, investigating the wilt disease of cotton (due to attacks of *Fusarium* species), have found that environmental conditions are important factors in relation to susceptibility, and in particular soil management can control the disease. A striking example of this is furnished by the work of B. B. Mundkur, who shows conclusively that in the case of *Fusarium vasinfectum* the American variety could not attack American cottons on Indian soils, and will not attack Indian cottons in any circumstances, whilst Indian cottons are less susceptible to the Indian variety of *Fusarium* on American soils. It is interesting to note that American soil in affected districts is light sandy and acidic, whilst affected Indian soils are heavy clayey and alkaline. Soil conditions (mainly physical) have also been found by J. Madhusudan Rao and Yeshwant D. Wad to be responsible for development of leaf roll and red leaf in American cottons.

With reference to anatomical developments in relation to disease, B. P. Pal shows that in certain varieties of gram (*Cicer Arietinum* L.) which are affected by the cutworm, those which are relatively immune have large stem diameters and extensive development of woody tissues, while severely attacked varieties show a smaller stem diameter and poorly developed secondary wood.

In most cases work has been carried out under field conditions and in connexion with various growers, so that some very interesting statistics are possible in view of the quantity of material available.

Progress in Building Research

A PERUSAL of the report of the Building Research Board for 1935 recently issued by the Department of Scientific and Industrial Research (H.M. Stationery Office. 3*s*. 6*d*.) shows how elementary is our scientific knowledge of building technique. In his introductory survey of the recent work of the Board, Dr. R. E. Stradling, the director of research, suggests that a wrong emphasis has been given by concentrating on the engineering side, strength and stability of structure being studied to the neglect of other equally vital considerations associated with the "Efficiency of Buildings from the Standpoint of the User".

Recent developments have given special prominence to three of these problems, especially in connexion with slum clearance schemes. The increase of noises of all kinds and the influence of mechanical continuity, as adopted in modern construction, in causing a sound made at one point to be extended over a large area, have made the sound insulation problem serious and pressing. The results of earlier work on walls, partitions and floors, treated individually, have focused attention on the interaction of the several elements of a building, and this is now being investigated with the full realization of treating the building as a whole. Trials are in progress on a frame building, on the principle that the construction should be such as to confine the noise to the room in which it is made; and this is arranged as a box, built into, but acoustically insulated from, a structural framework. It is appreciated that unforeseen troubles may arise in the full-scale developments, but "these must be overcome for the need is urgent".

From the same source comes the difficult problem of bug infestation, in which the survey work carried out has shown that virtually every urban authority is more or less troubled with this problem. Dr. Stradling urges that the building industry should endeavour to contribute to its solution by preventing the formation of cracks and by devising a form of construction which will, when the need arises, admit of disinfestation by the poisonous gases at present used, without danger to the occupants of surrounding houses.

It is claimed that considerable advance has been made towards placing the investigation of fire resistance on a scientific basis by the provision of a fire-testing station at Elstree, where full-size building elements are tested and graded in accordance with the new specification. Arrangements have been made for a programme of research covering not only the investigation of different forms of construction but also of tests of proprietary systems with the view of issuing appropriate certificates.

In the demolition of Waterloo Bridge, opportunity has been taken to investigate the condition of granite after exposure for 120 years. The outer half-inch was found to be seriously affected, but no reason appeared to suggest that decay would have become apparent in the near future had the structure been undisturbed. Laboratory examination of Portland stone from St. Paul's Cathedral also showed that, except for surface portions, the material was sound and, with regard to the use of old stones, the report states that, in the case of the more durable kinds, provided an appropriate thickness is removed, these should prove as good as new.

Materials for cleaning buildings have been under review, and a number of proprietary preparations investigated. It is pointed out that it is inadvisable to use chemical methods, and that alkalis are equally as dangerous as acids. Examples of the deleterious effects of cleaning in stone walls, door jambs, etc., are quoted.

Work on the effect of firing conditions on the properties of bricks has shown that specimens fired to below 900° C. offered only a moderate resistance to disruption by the crystallization of soluble salts whereas, with one exception, all the clays tested proved satisfactory in this respect when fired to 1,000° C. The unsightly efflorescence on brickwork is caused by soluble magnesium compounds, particularly the sulphate, contained in the bricks, and the only certain method of its elimination is firing to a temperature of above 1,050° C.

The report also contains particulars of tests made on the heating, cooling and lighting of buildings. The notable difference in the temperatures inside a wooden shed, before and after whitening it, is shown in the results of one inquiry, while the diminution of the lighting of a room due to a balcony or neighbouring building is the subject of another. Particulars of the work carried out in conjunction with other bodies and on behalf of manufacturers, indicate the value of the scientific services rendered by the Building Research Board both to the industry and to the interests of the public.

The Machinery of the *Queen Mary*

THE ninth Thomas Lowe Gray lecture was delivered before the Institution of Mechanical Engineers on January 8 by Mr. John Austin, superintendent engineer, Cunard White Star, Ltd., and took the form of a description of the main and auxiliary machinery of the *Queen Mary*.

Mr. Austin pointed out that since the advent of steam propulsion, the trend of development in the design of Atlantic liners has been towards larger and faster ships, and the several commercial and technical considerations which determined the size and speed of the new vessel were explained. Before a decision was taken as to the type of machinery to be installed, a committee of eminent engineers was invited to advise the directors, and they unanimously recommended high-pressure water-tube boilers with superheaters and air-preheaters and, for propulsion, single reduction geared turbines as being most suitable by reason of their reliability, simplicity, lightness, efficiency and freedom from noise and vibration. To meet emergencies and to maintain the fortnightly schedule, a large reserve of steaming capacity was provided and, in relation to the normal power required, it is of particular interest to the engineer to note how much design of hull and propellers has improved. From the table of figures given, the *Lucania* of 1893 had a gross tonnage of 12,952, horse-power 27,650 and speed 21·9 knots. The *Queen Mary* has 6·2 times the tonnage, but only 5·7 times the horse-power, although her speed is 1·2 times that of the *Lucania*.

The arrangements to ensure economy and to obviate delays and damage are as complete as human ingenuity can make them. Salt-water detectors are fitted at every point where salt-water might leak into the feed-water system, and give audible and visible warning when the concentration reaches 2 grains per gallon. Automatic feed-water regulators ensure a steady water-level in the boilers. The adoption of the closed stokehold system of forced draught has obviated the need for massive air ducts, and maintains better ventilation and working conditions. Each boiler has a complete system of steam soot blowers, and the arrangement by which boilers and propelling machinery have been divided into two quite independent systems—only practicable in a ship of such large size and power—ensures that, in the event of breakdown in one section, the whole propelling machinery is not put out of action.

The steering and manœuvring of a ship of this size necessitates a rudder of large area and, this being of streamline unbalanced type, powerful operating gear had to be installed. The torque is supplied by four hydraulic rams acting on tillers projecting from the rudder-stock. For safety, the essential parts were duplicated and the pumps are driven by three electric motors each of 250 h.p., the switchboard of which is operated by servo gear of the electro-hydraulic type controlled by hydraulic telemotors working in conjunction with the steering wheel on the bridge.

Crystalline Structure of Cellulose

PROF. K. H. MEYER reviews in the February issue of the *Berichte der deutschen chemischen Gesellschaft* the evidence upon which the structure of the crystalline part of cellulose has been based, and suggests that certain alterations are needed in the accepted model which was constructed from X-ray intensity measurements carried out by Andress in 1929.

Fortunately, the existing calculations upon the dimensions of the micelles or crystallites remain for the most part undisturbed, since the latter are independent units and the cellubiose type of linkage is not challenged. But the grouping of the micelles needs reconsideration. Hitherto it has been assumed that they all run in the same direction.

There seems to be no valid proof that this is the case, and the fact that *precipitated* hydratcellulose possesses the same crystal lattice as that of the mercerized fibre makes it highly improbable that all the chains are similarly orientated. There is, in fact, no reason why an equal number of chains should not be formed in opposite directions by precipitation.

Moreover, the minor alterations in dimensions, which have resulted from new X-ray intensity measurements, show that the suggested new model, in which the crystallites are arranged to run alternately in opposite directions, is more in accordance with measurements than the older one. In particular, there is no longer any need for deviations from the tetrahedral angle in the side-chains, and the recalculated distance of 2·6 A. between hydroxyl groups of neighbouring chains, agrees well with the recent measurements by Bernal on hydroxyl distances.

It is known that a small amount of oxidation occurs in native cellulose and it is suggested that the resulting acid groups may esterify with neighbouring micelles. This may account for the resistance to methylation observed by Karrer to the extent of about 8 per cent of the hydroxyl groups. No information could be derived about the ends of the chains, but it is pointed out that in the new model the terminal aldehyde groups might lose their identity by forming glucosidic links with the terminal alcoholic groups of the other micelles to form giant rings.

Birmingham Conference on Industrial Physics

THE rapid development of industrial applications of physics to industry in recent years has brought with it the desire for opportunities for the interchange of ideas and for the discussion of the many and varied topics which have consequently arisen. The more enterprising industrialist also desires opportunities of learning of these latest developments in order to keep himself abreast of his competitors, especially those abroad. The Institute of Physics is endeavouring to meet this demand by founding branches both at home and overseas, and by holding periodic conferences on industrial physics. The first Industrial Physics Conference to be held took place in Manchester in 1935 (see NATURE, April 6, 1935, p. 555) and the second was held in Birmingham on March 8–20, the subject being "Optical Devices in Research and Industry".

The sessions were held in the University of Birmingham. The Conference was formerly opened by Mr. Walter Barrow, pro-chancellor of the University, and was presided over by the president of the Institute, Prof. A. Fowler. Following the established practice of the Institute, the lectures were all informal in character and were followed by discussions. Neither the lectures nor the subsequent discussions will be published, except the presidential address, which will appear in an early number of the *Journal of Scientific Instruments*; the title of this address was "Spectroscopy in Industry". The other lectures were: "Colorimetry, Spectrophotometry and the Inspection of Manufactured Products for 'Appearance'", by Mr. R. Donaldson, of the National Physical Laboratory; "The Application of Electron Diffraction to Industrial Problems" by Prof. G. I. Finch, of the Imperial College of Science and Technology; "Industrial Uses of Photocells" by Mr. A. L. Whiteley, of the British Thomson-Houston Co., Ltd.; "Optical Gauges for Metrology and Engineering" by Mr. F. H. Rolt, of the National Physical Laboratory; "Polarimeters, Saccharimeters and Refractometers in Sugar, Jam-boiling and other Industries", by Mr. L. Eynon, of Messrs. Eynon and Lane, official analysts to the Sugar Association of London. The attendance at each of the lectures was excellent, averaging 325. Both the lecturers and those who took part in the subsequent lively discussions dealt with recent industrial applications of the various optical and allied devices and the associated problems, rather than with the technical details and underlying principles of the devices themselves.

On March 20 parties of Conference members were able to see the direct application of physics to industry in the Longbridge Works of the Austin Motor Co., Ltd., the engineering works of the General Electric Co., Ltd., and the Research and Development Department of the Mond Nickel Co., Ltd., as well as the associated works of Messrs. Henry Wiggin and Co., Ltd.

Twenty-three firms and research organizations were represented at an Exhibition of apparatus, instruments and books cognate to the subject of the Conference, which was held in the physics laboratories of the University. The Government's recognition of the importance of physics to industry was demonstrated by several exhibits contributed by the National Physical Laboratory and the Post Office Engineering Research Station. A special section of the exhibition was devoted to optical experiments of general interest, including many ingenious applications of photocells. The object of the whole Exhibition was to demonstrate the existence of apparatus and instruments designed on well-known physical principles for use in the workshop and factory. It was agreed, even by those familiar with the subject, that the wide range covered by the devices shown was considerably more extensive than is generally appreciated. Many instances were recorded in which responsible executives were enabled by this Conference and Exhibition to learn of the existence of devices which should prove of the utmost value in their factories. A limited number of copies of the catalogue of the Exhibition is still available from the Institute of Physics, London, S.W.7 (9*d*. post paid). The educational value of the Exhibition was appreciated by the local schools, and it was visited by parties of senior scholars from them. It is estimated that about 2,500 people visited the Exhibition during the three days that it was open.

Prof. J. A. Crowther, honorary secretary of the Institute, broadcast a talk about the Conference and Exhibition on the eve of its opening, and it also received extensive attention from both the lay and technical press. There was thus further confirmation of the fact that there exists a great demand for information about recent scientific discoveries and particularly their application to industrial and domestic problems.

No report of the Conference would be complete without recording the valuable contacts which resulted from bringing together physicists and industrialists, and the great help rendered by the authorities and members of the staff of the University of Birmingham. HERBERT R. LANG.

Science News a Century Ago

Egyptian Mummies

THE *Gentleman's Magazine* of April 1837 relates that "on March 6 at the close of a series of six very interesting and instructive lectures on Egyptian antiquities delivered at Exeter Hall by Mr. Pettigrew that gentleman unwrapped a mummy presented for the occasion by Mr. Jones of the Admiralty. The inscription on the outer case differed from that on the inner. Both stated the party to have been a female, but the names and genealogies were different, and the latter stated the mother of the deceased to be living when her daughter died. It might be that the wrappings would settle this point; which, however, they did not—for no name was found on them, as often occurs. The mummy was Greco-Egyptian, and embalmed after the ancient manner, the bowels being extracted by an incision on the left flank, and the brains probably through the nostrils, as the nose was much broken. The legs were separately bandaged, and the ankles bound by strips of painted linen, about half an inch in breadth. The figures were not hieroglyphic, but simply ornamental. Bands of the same kind surrounded the arms, which were crossed upon the breast; and a similar circle went round the neck, with a thin golden scarabaeus in front. On each knee was also a thin piece of gold, resembling the lotus-flower; over each eye the providential eye of Osiris of the same material, and another golden ornament upon the top of the ridge of the nose. The upper wrappers were not voluminous, and of coarse nankeen-coloured linen. Then came a complete envelope of asphaltus, and below that the usual disposition and extent of linen robes. On the soles of the feet were slight sandals, transversely striped, black, white, and red, exactly like those painted at the bottom of the inner cases. The finger- and toe-nails were gilt, and there were rings on the fingers."

Henslow's "Descriptive and Physiological Botany"

THE first article in the *Athenæum* of April 8, 1837, contained a notice of Prof. Henslow's "The Principles of Descriptive and Physiological Botany". John Stevens Henslow (1796–1861) was professor of mineralogy at Cambridge in 1822–27 and professor of botany in 1827–61. It was he who recommended Darwin as naturalist to H.M.S. *Beagle*. "If any person," said the *Athenæum*, "doubts the truth of the opinion now prevalent, that Botany has of late years undergone a great revolution . . . he has only to compare the introductory work of Professor Henslow with that of Smith, which although now almost forgotten, was, only a few years since, a standard book upon the subject in this country. . . . As a genuine view of the state of opinions upon physiological and structural botany up to the year 1836, we regard the work of Professor Henslow as a valuable addition to our introductory books. It embraces all that is most worthy of the student, briefly expressed in a clear methodical style, and, in general, with a just distinction between those modern speculations which are founded upon exact observations, and those which are mere creations of an inventive imagination."

Prony's Absorption Brake

UNDER the heading "Dynamometric Check", the *Mechanics' Magazine* of April 8 said: "A Committee of the French Institute, composed of Messrs. Arago, Dulong and Poncelet, has gone through a series of experiments on the 'dynometric (or power-measuring) check', an instrument invented by Prony, and lately improved by M. de Saint Leger, mining engineer at Rouen, for the purpose of measuring with accuracy the power of steam-engines and the quantity of fuel they consume. A large party of members of the Institute and Chamber of Deputies, of professors, engineers, etc., were present at the investigation. The object of the experiments was to ascertain the practical exactness of the apparatus, and for this purpose a steam engine of twelve horse-power of M. Pauweis's manufacture was made use of. The result appeared to be perfectly satisfactory and the scientific world now waits, with some interest, the report of the Committee of the Institute."

Baron de Prony (1755–1839) the inventor of the friction dynamometer, was distinguished both as a mathematician and engineer. He was trained under Perronet at the Ecole des Ponts et Chaussées and himself in 1799 became the director of the school. During the Revolution he directed the preparation of an enormous series of logarithmic tables computed to fourteen, nineteen and twenty-five places of decimals, and under Napoleon superintended the operations in connexion with the regulations of the waters of the River Po, and the draining of the Pontine Marshes.

Societies and Academies

Paris

Academy of Sciences, February 22 (*C.R.*, 204, 533–624).

HENRI LAGATU and LOUIS MAUME: The possibility of measuring separately, at any period of growth, the feeding effect and improving effect of an application of manure. The method is based on the analysis of a leaf removed from the plant at regular intervals.

EDOUARD CHATTON and MME. SIMONE VILLENEUVE: The division of the mouth and the formation of the peristome in *Cyclochæta astropectinis*. Their immediate genetic continuity.

RENÉ GARNIER: Two classical theorems of conformal geometry.

D. MANGERON: Certain problems at the polygonal boundary not totally characteristic for a class of partial differential equations of higher order.

M. LUNTZ: Alternating thermoconvective vortices in a thin layer.

DOUCHAN AVSEC: Thermoconvective vortices in superposed layers.

ALBERT TOUSSAINT and SIMON STRIJEVSKY: The envelope curves of the yield for the best propelling screws.

SVETOPOLK PIVKO: The flow of air in the plane of rotation of a supporting helix.

RENÉ RETEL: Supplying fuel to a motor with combustion at constant pressure.

ASSÈNE DATZEFF: The passage of corpuscles through potential barriers.

BERNARD KWAL: The classical dynamics of the electron. Theory of prime functions and the true moment of the electron.

PIERRE VERNOTTE: The simultaneous determination of the specific heat and the thermal conductivity of insulators. Method of the signal.

JEAN TERRIEN: Stimulation of the CuCl bands by fluorescence in the vapour of cuprous chloride.

FRED VLÈS and ERWIN HEINTZ : The interpretation of the infra-red spectrum of the proteins. The qualitative and quantitative recognition of the constituent amino acids in the spectra of the proteins is in accord with Fischer's theory of the peptide structure of the proteins : it also supports to some extent the diketopiperazic theory of Abderhalden. It appears to be opposed to the polycyclic theories, which assume a structure where the amino acids are not preformed in the protein molecule.

PAUL SOLEILLET : The passage of the Zeeman phenomenon to the Paschen-Back phenomenon of hyperfine structure in the polarization of resonance radiations.

PIERRE AUGER and MME. GRIVET MEYER : The secondary effects of cosmic rays in free air and in the subsoil.

NARCUS BRUTZCUS : Contributions to the thermochemistry of the hydrocarbons.

ALBERT MICHEL-LÉVY and HENRI MURAOUR : A series of photographs of phenomena accompanying the detonation of an explosive taken at intervals of 0·00001 sec. From earlier experiments, the authors had drawn the conclusion that the intense luminous phenomena caused by the detonation of explosives are caused by the action of the shock wave on the surrounding atmosphere and not to the explosion gases. This view is confirmed by the photographs now described and illustrated.

RENÉ PARIS and PAUL MONDAIN-MONVAL : The influence of small quantities of metallic oxides on the crystallization of zinc borate.

PIERRE DONZELOT and JEAN BARRIOL : The oscillations of the carbon chain of the benzene molecule.

MAURICE BONZEL : The disturbances brought about by cold hardening on the dilatometric diagram of metals.

ADRIEN PERRET and ALBERT BANDERET : The relations between cyanide, cyanamide and nitride in some elements of the rare earth group.

MAX GELOSO and MLLE. EVELINE GIORDANO-ORSINI : The precipitation of copper sulphate by soda.

MARC TIFFENAU and PAUL WEILL : The dehydration of divinylglycol by sulphuric acid. Transposition of the hydrobenzoin type with migration of the vinyl radical. Divinylglycol, dehydrated with 50 per cent sulphuric acid, gives mainly vinylcrotonic aldehyde.

PAUL RUMPF : The synthesis of the aminosulphonic acids in the fatty series. Introduction to their electrochemical study.

EDMOND URION and ERNEST BAUM : The catalytic and acid dehydration of divinylglycol. The temperature of the dehydration appears to be the main factor determining the nature of the aldehyde produced by the action of catalysts.

B. MARTIN : Curves of dispersion of the reflective powers of some natural tellurides.

PAUL GAUBERT : The diffusion under the action of heat of the colouring material in crystals of artificially coloured phthalic acid.

LOUIS ROYER : The thermoluminescence of certain crystallophyllian and eruptive rocks of Algeria.

PIERRE COMTE : The Cambrian and Silurian series of Léon (Spain).

GEORGES CHOUBERT : The geology of the middle Moulouya and the eastern end of the Haut-Atlas.

CHARLES BOIS : Comparison between the values of the focal depth of earthquakes determined by means of Wadati tables and those obtained by means of Brunner curves.

GUSTAVE NICOLAS and MLLE. BERTHE AGGÉRY : The persistance of chlorophyll as a result of bacterial action.

EMILE MICHEL-DURAND : The alteration of the nucleic compounds of plants in the course of their extraction in a trichloracetic medium. Experiments proving that contact with a cold 10 per cent solution of trichloracetic acid produces a notable alteration in the nucleic compounds of the tissues.

RENÉ MORQUER : Morphogenic researches and vital concurrence in the Hypocreaceæ growing on vines.

MAURICE DE CARAMAN and CHRISTIAN CHAMPY : The supposed sterility of the tiger lily (*Lilium tigrinum*) due to its triploid nature.

GUSTAVE MALÉCOT : Some consequences of Mendelian heredity.

LUCIEN BALOZET : The evolutive cycle of *Brachylæmus suis*.

Amsterdam

Royal Academy (*Proc.*, **40**, No. 1 ; 1937).

F. M. JAEGER : Relative and absolute spatial configuration of isomorphous, optically active, complex salts of trivalent cobalt and rhodium. (1) Comparison of the triethylenediamine and tricyclohexanediamine salts.

F. M. JAEGER and L. BIJKERK : Investigations on complex salts of racemic and optically active cyclohexane-1-2-diamines with trivalent cobalt and rhodium. (1) Trans-cyclohexane-1-2-diamine and its fission into optically active antipodes.

J. BÖESEKEN and E. DE ROY VAN ZUYDEWIJN : Some properties of unsaturated sulphanes.

C. U. ARIENS KAPPERS : The spread of primitive humanity and its links with the more differentiated races as revealed by cephalic and cranial index curves.

P. J. HARINGHUIZEN and D. A. WAS : Investigation of thin layers of tin and other metals. (3) The interaction between metals and lubricating oils. Corrosion tests on copper, tin and lead in lubricating oils. The viscosity, surface tension and acidity of the oil are not influenced by reaction with the metal.

D. SCHEPEL : The number of lattice points on and in the neighbourhood of certain curves.

H. FREUDENTHAL : Manifolds and their representations.

N. ARONSZAJN : The lacunæ of a polyhedron and their relations to Betti's groups.

H. G. BUNGENBERG DE JONG and L. W. J. HOLLEMAN : Examples of stable unmixing in binary systems : salt and water. The bichromate of novocain in water shows the phenomenon of stable unmixing at 74° C. (co-existence of two liquid layers).

E. GORTER and L. MAASKANT : (1) The spreading of protamine insulinate. (2) The spreading of urease and Bence-Jones protein.

S. DE BOER and A. BROUWER : The action of medicines on auricular fibrillation. (2) The action of hydroquinidine, quinidinum purissimum, hydroquinine and quininum purissimum on auricular fibrillation.

I. M. KOLTHOFF : Ageing of fresh precipitates in contact with a liquid medium. The irreversible flocculation of colloids.

Sydney

Royal Society of New South Wales, December 2.

H. G. RAGGATT: Probable late Silurian age of Serpentine, Condobolin-Trundle District, N.S.W. The dominant rocks of the Condobolin-Trundle district are cleaved argillaceous sediments which fossil evidence indicates are Silurian in age. Devonian rocks overlie the Silurian with marked unconformity. Serpentine and other basic rocks are found intruding the Silurian and cleaved in like degree. Pebbles of serpentine are found in basal Devonian (Middle to Upper) conglomerates. It seems probable, therefore, that the Serpentine was intruded during the late Silurian diastrophism.

R. G. GIOVANELLI: Energy distributions in the spectra of some gaseous discharge tubes. A spectroscope having been fitted with a wedge-shaped slit, the continuous spectrum was compared with black-body radiation, and found to have a colour temperature of about 5000° A. The energies in the lines were determined in terms of continua, and the total luminosities associated with the lines and continua compared.

H. FINNEMORE and D. K. LARGE: Cyanogenetic glucosides in Australian plants (6). *Goodia lotifolia*. An unstable cyanogenetic constituent. *Goodia lotifolia* Salisb. the so-called clover tree, yields in the fresh condition 0·14 per cent of hydrocyanic acid, corresponding to 0·86 per cent on the material dried at 100°. When dried in the air for two days, about 75 per cent of this was lost; the rate then slows down and after about a month only a trace is present. Museum specimens are therefore negative. Steaming for ten minutes removed more than 99 per cent of the acid present. The acetone extract on careful drying and washing with dry ethyl acetate yielded the glucoside of parahydroxybenzaldehyde, recognized after its hydrolysis with emulsin by its constituents and by the hydrolysis of its phenyl hydrazone. Associated with this glucoside was an unstable cyanogenetic material, possibly its cyanhydrin, which continuously gave off hydrocyanic acid, the richest sample contained 2·9 per cent, the whole of this being removed by ten minutes' steaming.

A. R. PENFOLD and F. R. MORRISON: The occurrence of a number of varieties of *Eucalyptus radiata* (*E. numerosa*) as determined by chemical analyses of the essential oils (2). A tree planted from the seed of *Eucalyptus radiata*, Variety *A*, threw two stems from the one root system. The leaves and terminal branchlets were separately examined, when the essential oils were found to differ from one another not only in yield, but also in chemical composition. This provides definite confirmation of the contention that a species described as *Eucalyptus Lindleyana*, Variety *stenophylla* by W. F. Blakely in 1934 does not exist, for the evidence shows that *E. radiata* (*E. numerosa*) and Blakely's variety *stenophylla* have been found growing together on one and the same plant. This observation will exert a considerable influence not only on the economics of the eucalypts, but also upon the botanical classification of this important group of trees.

H. J. HYNES: Species of *Helminthosporium* and *Curvularia* associated with root-rot of wheat and other graminaceous plants. It is pointed out that seven distinct species of *Helminthosporium* have been isolated by various workers from foot-rot-affected wheat in different countries. Of these, three have been isolated and studied by the author from Australian material. The morphological characters of isolates of each of these species are discussed, and it is pointed out that as a result of K. B. Boedijn's new classification in which the small-spored species of *Helminthosporium* are included, the species *Helminthosporium M.* should now be designated as *Curvularia ramosa* (Bainier) Boedijn, and *H. tetramera* as *C. spicifera* (Bainier) Boedijn. The principal features of the new genus, *Curvularia*, are outlined.

Vienna

Academy of Sciences, December 17.

FRANCES G. WICK: Triboluminescence. Triboluminescence may be due to electrical discharges through the air around the crystal, or to radiation from centres in the crystal. These centres may be produced by X-rays, or they may be a characteristic of the crystal itself. In the latter case, they can be destroyed only by pulverizing the crystal.

HANNE LAUDA: Decay of the latent image on the photographic plate. The decay of the latent image is greater at high temperatures, at high intensities of illumination, and for low densities.

KASIMIR GRAFF: Colorimetric measurement of stars down to mag. 6·3 between 10° and 40° S. Decl.

S. REISCH: Galvanomagnetic method of measuring small displacements. The displacement is communicated to a coil of bismuth wire in a magnetic field, and the resulting change of resistance is measured.

G. KOLLER and H. CZERNY: Limonin, the bitter principle of orange seeds.

KARL FEDERHOFER: Normal vibrations of an axially compressed circular cylindrical shell.

K. KARAS: Normal vibrations of non-uniform strings.

January 14.

F. WESSELY and K. JENTZSCH: Bitter principle of Columbo wood (5). Methylation of columbin.

JULIUS PIA: Tectonics of the Prague Dolomites (South Tyrol).

ALFRED JELINEK: (1) Mechanics of periodic mountain winds. (2) Production of periodic mountain winds by thermal fluctuations.

A. BURGER and E. EKHART: Daily circulation of the atmosphere in Alpine regions.

JOSEF PRIEBSCH and H. KRAMER: Effect of temperature on cosmic rays. Observations at Hafelekar (2,300 m. above sea-level) with an unscreened Steinke apparatus show that there is a temperature effect with even the softest cosmic rays. The sign of the correlation coefficient, however, changes during the course of the year, being positive in summer and negative in winter. Observations with a screened apparatus give a negative correlation coefficient throughout the year.

F. HERITSCH: Rugose corals from Timor, Djoulfa and the Salt Range, with notes on the stratigraphy of the Permian.

January 21.

GEORG KOLLER and HERTHA RUSS: Constitution of solorinic acid.

K. W. F. KOHLRAUSCH and R. SKRABAL: Studies of the Raman effect (64). Cyclopentane and cyclobutane carboxylic acids and their derivatives.

FRANZ BUKATSCH: Influence of the thermal waters of Bad-Gastein on the assimilation of carbonic acid by various water plants.

HERBERT HABERLANDT: Luminescence of fluorites and other minerals (3).

EMIL HAUCK: Cranial form of the coyote (*Canis latrans*).

Forthcoming Events

Monday, April 5

VICTORIA INSTITUTE, at 4.30.—Dr. E. W. G. Masterman: "The Dead Sea and the Lost Cities of the Plain".

SOCIETY OF ENGINEERS, at 6.—Inaugural Meeting. B. B. Tarring: Presidential Address.

Wednesday, April 7

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, at 7—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Dr. W. F. Bewley and E. S. Shoults: "Some Problems in the Heating and Ventilation of Glasshouses".

Thursday, April 8

ROYAL ASIATIC SOCIETY, at 4.30—(at the Royal Geographical Society).—Dr. Ernest Mackay: "Further Excavations in the Indus Valley".

Friday, April 9

OIL AND COLOUR CHEMISTS' ASSOCIATION, at 7—(at the Manchester Ltd. Restaurant, Cross Street, Manchester).—Annual General Meeting.

Appointments Vacant

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

JUNIOR SCIENTIFIC OFFICER (physical chemistry) at the Torry Research Station—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (April 13).

HEAD OF THE ENGINEERING DEPARTMENT in the Hull Municipal Technical College—The Director of Education, Education Offices, Guildhall, Hull (April 17).

ASSISTANT (Grade III) in the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (April 17).

LECTURER IN MATHEMATICS in University College, Dundee—The Secretary, The University, St. Andrews (April 30).

PROFESSOR OF GEOLOGY in the University of Bristol—The Registrar (May 1).

TWO ASSISTANT LECTURERS IN MATHEMATICS in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 1).

RESEARCH ASSISTANT IN FRUIT PRODUCTS at Long Ashton Research Station—The Registrar, The University, Bristol.

ASSISTANT (Grade II) in the Royal Airship Works, Cardington—The Superintendent (April 9) (quote Ref. B.351).

Official Publications Received

Great Britain and Ireland

Empire Economic Union. The British Colonial Empire and the German Claim. Pp. 33. (London: Empire Economic Union.) 6*d*. [83

University of Oxford: Bureau of Animal Population. Annual Report, 1935–36. Pp. 48. (Oxford: University of Oxford.) [83

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1935. Vol. 70, Part 2: Prices and Supplies of Agricultural Produce and Requirements in England and Wales. Pp. ii+103–191. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [93

Mui Tsai in Hong Kong and Malaya: Report of Commission. (Colonial No. 125.) Pp. ix+314. (London: H.M. Stationery Office.) 5*s*. net. [93

Memorandum presented by ULAWS to the Select Committee on Agriculture (Damage by Rabbits) of the House of Lords, with Selected Supporting Statements. Pp. 32. (London: University of London Animal Welfare Society.) 1*s*. [103

National Institute of Agricultural Botany. Seventeenth Report and Accounts, 1935–36. Pp. 29. (Cambridge: National Institute of Agricultural Botany.) [113

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 18, 1936. Pp. 172. (London: Chemical Engineering Group.) 21*s*. [123

Philosophical Transactions of the Royal Society of London. Series B, No. 542: On the Nervous System of the Starfish *Marthasterias glacialis* (L.). By J. E. Smith. Pp. 111–173. (London: Harrison and Sons, Ltd.) [123

Fourth Annual Report of the New Commonwealth Society and Institute, 1935–1936. Pp. 80. (London: New Commonwealth Society.) [153

Reports of the Progress of Applied Chemistry. Vol. 21, 1936. Pp. 875. (London: Society of Chemical Society.) [163

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1936, presented to the Annual Meeting, February 8th, 1937. Pp. 48+7+8 plates. (York: Yorkshire Museum.) [173

Researches published from the Wards and Laboratories of the London Hospital during 1936. Pp. iii+20 papers. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net. [173

Other Countries

Bulletins of Indian Industrial Research. No. 5: Improved Reflex-Copying. By N. Kasinathan. Pp. iv+7. (Delhi: Manager of Publications.) 4 annas; 5*d*. [83

Nigeria. Report on the Forest Administration of Nigeria, 1935. Pp. 30. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 2*s*. 6*d*. [93

U.S. Department of Agriculture. Technical Bulletin No. 556: Soil Conservation Reconnaissance Survey of the Southern Great Plains Wind-Erosion Area. By Arthur H. Joel. Pp. 68+14 plates. (Washington, D.C.: Government Printing Office.) 25 cents. [103

Jamaica. Annual Report of the Department of Science and Agriculture for the Year ended 31st December 1935. Pp. ii+91+iv. (Jamaica: Government Printing Office.) [103

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen 39: Het Klimaat van Nederland. E: Verdamping. Door Dr. C. Braak. Pp. 50. 0·40 fl. No. 106a, Ergebnisse aerologischer Beobachtungen, 24, 1935. Pp. iv+40. 1.50 fl. No. 108, Seismische Registrierungen in De Bilt, 22, 1934. Pp. viii+156. 0.70 fl. No. 115: Oceanographische en meteorologische Waarnemingen in de Chineesche Zeeën en in het Westelijk Deel van den Noord Stillen Oceaan. 2: Maandkaarten voor Juli–December (1910–1930). Pp. 48. 7.50 fl. ('s-Gravenhage: Rijksuitgeverij.) [113

Bernice P. Bishop Museum Occasional Papers. Vol. 12, No. 4: Check List of Pacific Pycidæ. By Richard Kleine. Pp. 8. Vol. 12, No. 5: New Species of Hawaiian Panicum and Eragrostis. By Leo D. Whitney and Edward Y. Hosaka. Pp. 6. Vol. 12, No. 6: Check List of the Cicindelidæ of Oceania. By Walther Horn. Pp. 12. Vol. 12, No. 7: Transfer of the Papuan Gouldia to the Genus Psychotria. By Harold St. John. Pp. 4. Vol. 12, No. 8: A Revision of the Hawaiian Species of Labordia described by H. Baillon. By Harold St. John. (Hawaiian Plant Studies, 4.) Pp. 12. Vol. 12, No. 9: New Species of Portulaca from South eastern Polynesia. By Karl von Poellnitz. Pp. 6. Vol. 12, No. 10: The Ampagioid Weevils of Southeastern Polynesia (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 38. Vol. 12, No. 11: Cladocera of Mauna Kea, Hawaii. By Masuzo Ueno. Pp. 10. Vol. 12, No. 12: Termites of Southeastern Polynesia. By S. F. Light and Elwood C. Zimmerman. Pp. 12. Vol. 12, No. 13: Geology of Lehua and Kaula Islands. By Harold S. Palmer. Pp. 36. Vol. 12, No. 14: The Staphylindæ (Coleoptera) of the Mangarevan Expedition. By Malcolm Cameron. Pp. 10. Vol. 12, No. 15: Miscellaneous Hawaiian Plant Notes, 1. By F. Raymond Fosberg. Pp. 12. Vol. 12, No. 16: The Hawaiian Geraniums. By F. Raymond Fosberg. Pp. 20. Vol. 12, No. 17: Cryptorrhynchinæ of the Austral Islands (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 20. Vol. 12, No. 18: Ants from the Society, Austral, Tuamotu and Mangareva Islands. By William Morton Wheeler. Pp. 18. Vol. 12, No. 19: Some Compositæ of Southeastern Polynesia (Bidens, Coreopsis, Cosmos and Oparanthus). By Earl Edward Sherff. Pp. 20. Vol. 12, No. 20: Cryptorrhynchinæ of Henderson, Pitcairn and Mangareva Islands (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 8. Vol. 12, No. 21: A Cryptorrhynchid from Marotiri (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 4. Vol. 12, No. 22: Orochlesis of Fiji (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 10. Vol. 12, No. 23: Cryptorrhynchinæ of the Society Islands (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 48. Vol. 12, No. 24: Vegetation of Flint Island, Central Pacific. By Harold St. John and F. Raymond Fosberg. Pp. 4. Bulletin 141: Fijian Plant Studies. By Albert C. Smith. Pp. ii+168. (Honolulu: Bernice P. Bishop Museum.) [123

Memoirs of the Indian Museum. Vol. 11, No. 4: Diplopoda of India. By C. Attems. Pp. 133–323. (Calcutta: Zoological Survey of India.) 5.14 rupees; 9*s*. 6*d*. [153

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography: Geological Survey. Memoir 204: Gold-Bearing Deposits on the West Coast of Vancouver Island between Esperanza Inlet and Alberni Canal. By M. F. Bancroft. (No. 2432.) Pp. ii+34. (Ottawa: King's Printer.) 25 cents. [153

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1936. (No. 2423.) Pp. iii+54. (Ottawa: King's Printer.) 25 cents. [153

Catalogues, etc.

pH Cambridge Recorders and Electrode Systems. (Folder No. 56.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Moll Recording Microphotometers. (MF 37.) Pp. 12. (Delft: P. J. Kipp and Zonen.)

A Catalogue of Rare and Valuable Books. (Catalogue No. 609.) Pp. 68. (London: Francis Edwards, Ltd.)

Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 12, March. Pp. 45–58+iv+4 plates. (London: Wild-Barfield Electric Furnaces, Ltd.)

Nickel, W.11: The Extraction of Nickel, with Special Reference to the Mond Process of Nickel Refining. Pp. 16. (London: Mond Nickel Co., Ltd.)

Soviet Russia Travel Handbook for 1937. Pp. 32. Visit the Soviet Union. Pp. 36. (London: Intourist, Ltd.)

A Catalogue of Books on Early Medicine and Surgery. (No. 531.) Pp. 44. (London: Bernard Quaritch, Ltd.)