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CONTENTS

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The Ready Supply of Cinchona and Quinine: an Urgent Need

UNDER the title "Ledger Bark and Red Bark", Mr. J. H. Holland contributes, in the current number of the *Kew Bulletin of Miscellaneous Information* (No. 1, 1932, pp. 1-17), an important paper upon the past and present position of cinchona cultivation and quinine production. He has gathered together the salient facts relating to the availability of quinine and he presents these to us, without criticism, brought right up to date and from the varied points of view of the several parties which are most concerned.

After a short account of the introduction of cinchona from South America to India and Java—a story too well known to need repetition here—Mr. Holland discusses the therapeutic value both of quinine and of the other cinchona alkaloids. Evidence is brought to show that the alkaloids other than quinine are regarded by medical experts to be, at least for some forms of malaria, quite as efficacious as quinine, which is the only cinchona alkaloid admitted to the "British Pharmacopœia". It may be pointed out that this is not just a return to the findings of the commissions in India in 1866, which recognised the value of cinchona febrifuge, but a distinct step forward. The old cinchona febrifuge was a mixture of all the alkaloids, whereas the new febrifuges, under such names as 'malarene' and 'totaquina', are the factory residues after most of the quinine has been extracted from the bark. This modern view of the value of the febrifuge is important, since, if it becomes generally accepted, it will ensure that the whole of the cinchona products can be utilised.

In the same paragraph of Mr. Holland's paper, the old bogy which has so often hindered the adoption of a forward policy in the production of quinine—the synthetic substitute—is, for the present at all events, laid to rest. Beprochin and plasmoquine have now been under trial, but, although it is claimed for the latter that it effectively prevents mosquito-borne malarial infection among a group of healthy individuals who take prophylactic doses, "both are costly to produce and it does not seem at all likely that they will take the place of the natural cinchona alkaloids".

From the observations made upon the species and varieties of cinchona at present under cultivation, it is clear that *Cinchona Ledgeriana* has the highest total alkaloid content. It and its hybrids will, therefore, be the best species to plant, except in special cases where *Cinchona succirubra* or

C. officinalis may have to be substituted. This will apply particularly when the locality which it is desired to plant is respectively below or above the optimum elevation for *C. Ledgeriana*. In India, this is approximately from 3000 feet to 5000 feet above sea-level.

With regard to countries other than Java and India in which cinchona is now cultivated, a short explanatory note would have made the position clearer. The citation of their names without such explanation may mislead those who are not well acquainted with the circumstances; for outside Java and India, the cultivation of cinchona amounts to no more than a few acres, and sometimes only to specimen trees.

It is to be regretted also that a more complete account of the present-day production of cinchona has not been given, for this, of course, has a very important bearing upon the present situation. The plantations of Java, which yield about ninety-four per cent of the world's supply of quinine, are allotted only a few lines, and most of the information given has been taken from Sand's account in the *Malayan Journal of Agriculture* of 1922. Moreover, such facts about the present position as are recorded refer mainly to Madras, the less important area in India. The figures relating to the areas under cultivation in India and to the amount of bark produced are taken from the Government reports for the years 1928–29 and 1929–30. Unfortunately, they give no true idea of the possible or probable annual Empire yield, for this depends upon the conditions of these plantations. About this a good deal can be gathered if the reports are carefully read all through. Such information is by no means revealed by the quoted figures. Furthermore, considerable attention is paid to the 753 acres in the Anamalais, still a speculative proposition, while the Government of India's undertaking at Mergui in Burma is not mentioned. The latter area is about the same size as the former, and its present state is described in reports of the Botanical Survey of India.

An important point to which Mr. Holland directs attention, however, is the fact that the cinchona industry has now little or nothing to fear from competition with the original sources of bark in South America.

The main purpose of the paper is to produce evidence of the need for the expansion of cinchona cultivation, to indicate the regions in which it might successfully be grown, to point to the most profitable species to cultivate, and thus to stimulate action by the grower, the manufacturer, and the user, which will result in an adequate supply of quinine at a price that will permit of its universal use by the malaria-stricken millions of the world. Having made these points, Mr. Holland leaves us to draw our own conclusions.

We have already published in NATURE (vol. 124, p. 881; 1929) an article upon the importance of this subject from the Empire point of view. As was pointed out there, the British Empire includes a large proportion of the malarial tracts of the world, and the late Sir Andrew Balfour estimated that the direct annual loss to the Empire by sickness and death due to malaria is between fifty-two and sixty-two million pounds sterling. The international aspect of malaria is shown by the fact that the League of Nations has set up an organisation for antimalarial work. There should be no need to lay further stress upon the necessity of increasing the production of cinchona and quinine. A perusal of the recent reports of the departments of the Governments of India, Bengal, and Madras, the only producers of quinine within the Empire, will show the present condition of our industry. The older plantation enclosures in Madras and Bengal, which extend to a good many square miles, have been entirely planted, so far as the land within them is suitable for cinchona. Fresh soil is no longer available; some years ago it became entirely exhausted. Unless an area be fallowed for a long period in forest, it will not produce a second satisfactory crop of cinchona. The present harvests are largely from the bark of dead and dying trees. Successful cultivation in the Anamalais is as yet by no means assured, and the Mergui area cannot be regarded as at all approaching a first-class area.

There has been no systematic working scheme, staffs are denuded, and research has been almost neglected. Our supplies will shortly decrease for lack of a forward policy under a single central control. Yet it has been estimated that, if India were to supply even her own needs, she would have to increase her output by eighteen times. What of the rest of the Empire? With the passage of time, land suitable for cinchona (and it has to be very carefully selected) has become more and more scarce.

Surely the time has come when steps should be taken to stimulate action. There is here a case which seems to call for active encouragement and aid in organisation, possibly by a small Commission set up by the Government at home which would survey the possibilities of producing cinchona, not only in India, but also in other parts of the British Empire.

The Politics of Science

What are We to do with our Lives? By H. G. Wells. Pp. vi + 148. (London: William Heinemann, Ltd., 1932.) 3*s*. 6*d*. net.

THERE is nowadays scarcely an issue of NATURE which does not call upon scientific men to unite for ends beyond the specialised discussion of their own work. That the appeal does not entirely fail of response is shown by the slowly growing professional and social organisation of the scientific world and by the formation of propagandist societies which seek to impress upon the general public the importance of science in industry and government.

All this activity indicates a growing conviction among scientific men that science has something to contribute to the modern world beyond her technical applications: that its spirit and method carry with them implications of a rule of life, for human society as well as for the individual, and of a vision for the lack of which the people perish.

The practical working out of this increasing desire for a political movement based on science has proved, however, unexpectedly difficult. Scientific men are inevitably busy and preoccupied, and by the standard of their needs they are poor. Their calling has in the past made for a high degree of individualism; they have been able to combine for discussion and publication but for very little else. Moreover, the tradition of the pioneers who worked for knowledge and disdained its material prizes has prevented the development of the powerful 'trade union' types of organisation which have elsewhere provided the economic foundations of policy. A far more serious obstacle has been that the world of science has never made up its mind what it wants from politics. It has never got within sight of a political programme of its own, and it appears to accept conventional party divisions as real and important just when the general deliquescence of politics has revealed them as the superficial things they are.

The book at present under review, though addressed to intelligent people in general and not specifically to scientific workers, is an attempt to impose the implications of science on the social and political world of to-day. Its distinguished author, himself a scientific man turned publicist, is perhaps more fitted than any other living writer to point the moral of our present discontents and to formulate political intentions for the world of science.

This book is really a highly concentrated essence, distilled from the author's sociological writings of the last twenty years. It looks back to the Samurai —the voluntary aristocracy of "A Modern Utopia" —and to the imagined State in "Men like Gods" "whose education was its government". It considers and rejects the experimental anthropomorphism of "God the Invisible King", and it carries on the scepticism about democratic institutions which has marked Mr. Wells's writings ever since "The New Machiavelli". It contains no new fundamental ideas, but it is mature and articulated beyond any other sociological book its author has produced; and it makes, very explicitly and with complete seriousness, a most daring proposal.

When, towards the close of the War, Mr. Wells sat down to consider what mankind must do to prevent the recurrence of that colossal tragedy, he discovered that, despite a respectable array of 'qualifications', he was very much at sea about a number of things which a properly educated citizen of the world ought to know. Fortunate in the possession of leisure and opportunity, he set to work, with the help of a number of distinguished specialists, to complete his education; and the result was three very important books the writing of which has left its mark on that at present under review. "The Outline of History" sought to tell the story of mankind from the primeval lair to the Peace of Versailles. "The Science of Life" recounts what is known of biology, especially in relation to human affairs; and "The Work, Wealth, and Happiness of Mankind" deals with the ways in which humanity earns its living at the present day. These three works form together a first draft of the necessary humanistic education of the future, and in the writing of them the author's distinctive political ideas have gained clarity and precision.

The present work, which replaces an earlier sketch called "The Open Conspiracy", contains the general conclusions of this mind-clearing process. It is a plan of world reconstruction made necessary by science and conceived in the scientific spirit. It does not claim to start a new movement. It is presented as a statement of a general tendency which its author perceives in the minds of intelligent contemporaries.

Mr. Wells maintains that the changes in the scale of effective human association which have been brought about by scientific discovery necessitate certain wide innovations in social structure and policy if mankind is to survive, let alone to profit fully by the possibilities which modern knowledge holds out. The realisation of these innovations, he asserts, is likely to become an

increasing preoccupation of intelligent people the world over; and in the service of these developing ideas we may hope to find expression and significance for our individual lives.

To this convergence of the creative intelligence of our race upon the political problems which science has set us to solve Mr. Wells gives the name of 'The Open Conspiracy'; *conspiracy* because it is conceived as a revolutionary movement paying no superstitious respect to established constitutional usages, and *open* because its principal method is the frank discussion and publicly announced intention which have long been the practice of the scientific world. His proposal is that constructively-minded people should deliberately and progressively possess themselves of the nerve-centres of the world in order to establish a responsible world directorate in control of human affairs.

The first necessity for the Open Conspiracy arises from the technical evolution of modern warfare. What in pre-scientific ages was a relatively harmless bickering of governments has now become a danger which threatens the very life of civilised mankind; and the sixty or seventy sovereign States, with their arms and flags and their propaganda of separatist loyalties, have proved themselves an impossible method of government in a world which every day becomes more complete in its interdependence. The Open Conspirator, therefore, will work for the ending of war in the only way whereby war can be made finally impossible: by the ending of national governments the peculiar sovereignty of which consists in their right of ultimate resort of arms.

It is not only war, however, which science has rendered inadmissible in the modern world. The industrial and financial anarchy which condemns that world to penury in the presence of plenty must also give place to comprehensive and responsible direction. Our major economic concerns, such as credit, fuel, power, transport, and food, can no longer be left to chaotic competitive production on an alleged basis of profit-seeking. They must become the objects of organised production for use.

This, however, does not mean that these matters must be subject to popularly elected committees or councils or parliaments at the mercy of an ill-informed and only intermittently attentive electorate. Mr. Wells maintains that real control should be in the hands of those who are sufficiently interested to exercise it seriously and competently. This control should be rendered responsible, not through elections made ridiculous by the arts of the politician, but through public criticism such as at present prevails in the scientific world. This rather startling proposal, which breaks sharply both with political and with industrial practice in Britain, merits a much more careful examination than is possible here. It recalls certain features of the social organisation of the Soviet Union and the Italian Corporative State—neither of which can be dismissed as a mere tyranny—and is curiously paralleled by a suggestion put forward some years ago over the signature of Mr. Lloyd George, that industrial concerns should be made responsible simply by the statutory publication of very full information about their activities.

In the third place, the Open Conspirator must take account of population in a way which no previous statesmanship has dared to do. He must take steps to prevent any such uncontrolled increase in numbers as would cash in mere low-grade proliferation the material abundance which science offers to mankind. It is suggested that universal knowledge of contraceptive methods, combined with quite minor changes in our social and economic arrangements, would relieve us of the present fear of over-population even in India and the East, and would also rob the practice of birth control of its dysgenic effects.

The Open Conspirator thus comes into necessary conflict with various religious and obscurantist bodies which at present seek to restrict the use of these important inventions in human biology. This, because of the value he attaches to free, abundant, and competent discussion and to the fullest diffusion of authenticated knowledge, he will in no wise regret. He will welcome also every opportunity to foster sound non-tendencious education. He will make no truce with those who seek to use the common schools to inculcate nationalism or obstructive theological dogmas, or who set up barriers against the dissemination of modern knowledge. He will work for an education which will liberate minds instead of repressing them, and will answer the natural curiosities of questing youth by telling, as completely as contemporary knowledge makes possible, the place and task of the new generation in the world-wide drama of mankind.

There is nothing essentially new about all this. The dream of a world ordered and peaceful, of mankind deliberately grasping its opportunities and rising to the measure of its great occasions, has gleamed ever and again in literature and statecraft since the Hebrew prophet spoke of nations which "should learn war no more". What *is* new is the sense of urgency, of an imminent choice

between world order and a disastrous retrogression from all the fine possibilities of the present day; and the conviction that a growing minority of intelligent people must add to their personal concerns an overriding solicitude about the unification of the world, must work for it and shape their careers towards it, and find in the promise of it their justification and significance. L. A. F.

A New History of the Middle Ages

The Middle Ages, 300–1500. By Prof. James Westfall Thompson. Vol. 1. Pp. xxx + 618. Vol. 2. Pp. vii + 619-1069 + xlvi. 42*s.* net. Abridged edition. Pp. xii + 466. 21*s.* net. (London: Kegan Paul and Co., Ltd., 1931.)

WE owe to an American professor what is probably the best extant account of the Middle Ages as a whole, in English and in moderate compass. Prof. Westfall Thompson was a pupil of Luchaire in Paris, and no doubt it is partly due to this fact that he maintains throughout the European aspect of the medieval period, which is so essential and at the same time so rare in popular general books written on it in English. One gains quite a new and a truer point of view about almost every part of the subject—feudalism, the rise of the towns, the Hundred Years' War, Flanders and the woollen trade—if one looks at it from the centre and not from the circumference. At the same time, it must not be thought for a moment that the author is anti-English. On the contrary, he is specially strong on the part played by English—and Irish—missionaries in spreading education and civilising the West. Where one feels a lack—and it is the same in Mr. H. G. Wells's "Outline"—is on the side of the superior English political development. It is well to know that in the earliest stage all the rising European monarchies had their 'curia regis' and the germs of a national assembly. But it is important also to realise how it came about that in England the nobles identified themselves with the national cause, whereas abroad it was left for the monarch to speak for the State. No doubt Prof. Thompson is well aware of this, and he probably omits it because it is so well known to English readers. But, all the same, it is a serious lacuna.

For the rest, one has little but praise to express. The author's learning is most extensive, and he refers in full bibliographies at the end of each chapter also to the most accessible modern books. He was a considerable contributor to the "Cambridge Medieval History", and has had the great good sense to wait until that monumental collective work was completed before offering a general conspectus from one pen and one co-ordinating mind. The difference in the effect on the reader is most marked. One only refers to the great compilations, to which we are now accustomed, in order to look up some particular point or see what one man thinks about one problem. But when a reader has once started this book, though it is well packed with facts, he is drawn on; the author is so full of his subject and so keen on its interest and importance that he holds attention from beginning to end.

Where the author fixes the beginning and where the end, are also interesting points. He begins with a sketch of the Roman Empire at the time when it was being permeated by Christianity, and his last sentence is one from Erasmus on the eve of the Reformation. "'In this part of the world,' wrote Erasmus in 1517, 'I am afraid a great revolution is impending.' He was right." From which it appears that to Prof. Westfall Thompson the medieval Church is the central thread of medieval history, and he also is right.

The book should, however, commend itself specially to readers of NATURE by the due space and appreciation assigned to the intellectual development, both in physical science itself and in general philosophy. The author analyses these carefully, and by frequent quotations from George Sarton shows that he is in touch with the chief repository of such learning, certainly in the United States, if not in the whole world. He discards the contemptuous view of the scientific attainments of the Middle Ages at their best, and is at pains to show that, though the masses everywhere were subject to the wildest superstitions, individual great minds were grappling with the deepest questions and in many cases anticipated, not indeed particular physical discoveries, but profound general ideas of later date.

In this matter, the contrast which is drawn between the contributions of Germany and Italy towards the end of the period is instructive and interesting. The author holds that it is to the reflective German minds of the last centuries of the Middle Ages that one must look for the origin of the development of pure scientific thought. In Germany and not in Italy one finds the unbroken line of great scientific thinkers, from Albertus Magnus—a German count—onwards to Copernicus, a Germanised Pole. In the last part of the fifteenth century the University of Cracow was ahead of Prague or Heidelberg, and as Poland was always

in close touch with Italy, largely through the University of Padua, it was German science, via Polish scholars, that at last awakened the spirit of scientific research in Renaissance Italy in the sixteenth century. Thus Galileo comes out at the end of one apostolic succession to become the first of another; and we may realise the inter-connectedness of us all.

The rôle of Italy in art was otherwise determined and more universally operative. It still contained, after all the ravages of the barbarian wars, by far the largest collection of ancient works of art in the West, and, being in touch both with Germany through the imperial connexion and with the East through Venice and the Crusades, it served as a radiating centre for all the art-forms of the later Middle Ages. The book has a few typical illustrations of comparative churches of Romanesque and Gothic style, and an abundance of good clear maps in colour, printed in Germany.

We have picked out for notice a few of the features specially congenial to readers of NATURE, but it should be understood that the author himself seems to be as many-sided as history. He is particularly enlightening on the battles of the Hundred Years' War and is an expert on armour; and his account of Joan of Arc strikes us as the justest and the most poignant rendering of that immortal and yet almost unbearable story perhaps possible in half a dozen pages.

There is issued at the same time an adequate and very competently abridged edition in one volume for college use. This retains all the main features of the larger work, including its excellent maps; it is only shortened by leaving out a number of personal details and certain political and military events. F. S. MARVIN.

Science as one of the Humanities

The History of Science and the New Humanism. By George Sarton. Pp. 178. (New York: Henry Holt and Co., 1931.) 2 dollars.

IN his recent book on "Clothes", Mr. Eric Gill says that "in our hearts we know science for what it is—the greatest frivolity of history. . . . If it was not that science enables a lot of people to get rich it would now be what it was before: the amusing hobby of charming old fools." While this statement is no doubt intended to be deliberately provocative, it unfortunately represents—if only in caricature—the opinion of many otherwise cultured men and women, who have somewhat surprisingly failed to realise that science is as essentially concerned with the philosophic values and the 'eternal ideas' as any other department of human intellectual activity. As followers of science, we know that the reproach is entirely unjustifiable, but to refute it is by no means easy. The difficulty lies mainly in the fact that, while the material results of science are immediately obvious, the philosophic framework of science, its methods, its aims, and the rigorous discipline of the laboratory, are scarcely to be comprehended, or even imagined, except by those who have had some considerable personal experience of scientific work. It is, however, clearly of the first importance that, in a world for which science has opened strange new vistas, and upon which she has conferred the power of limitless exploitation of natural resources, misconceptions of the ultimate character of science and misapplications of scientific knowledge should be removed as completely as possible.

This is one of the problems that Dr. Sarton discusses in his latest book, which, though slight in bulk, is a very valuable contribution to educational thought. He regards the difference of outlook between men of letters, historians, philosophers, the "so-called humanists", on one side, and men of science on the other, as "the most ominous conflict of our time". No simple solution appears possible, but much might be done by a wider teaching of the history of science, since this affords a means of conveying to humanity the real significance of science and its cultural value, which far transcends all its applications. Dr. Sarton rightly emphasises the fact that "there are no natural sciences as opposed to humanities; every branch of science or learning is just as natural or as humane as you make it. Show the deep human interest of science and the study of it becomes the best vehicle of humanism one could devise." If, as many will agree with Dr. Sarton in believing, such a desirable result may be largely achieved by a more general inclusion of the history of science in educational schemes, it would be folly to neglect a tool that lies so ready to our hands. Much has indeed already been done, but more remains to be accomplished.

Dr. Sarton is, however, too wise to believe that misvaluation of science is confined to the humanists, or that the faults are all on one side. Though, as he rather bitterly remarks, "science teachers are not expected to impart any education, but simply to teach their own technicalities", he is by no means sure that the science teachers themselves are not partly to blame for the invidious distinction between 'scientific' and 'cultural' courses. The man of science is too often aloof, assertive, self-

righteous, and incapable of appreciating branches of study outside his own; in short, he suffers from many of the very defects he rebukes in others. The remedy that Dr. Sarton would apply is again the study of history—not necessarily the history of science alone, though a modicum of the latter is essential. He would like to see a solid literary and artistic basis and an insistence on the historical point of view in all scientific education, while the more literary-minded students would receive frequent explanations of scientific methods by men familiar with the history of science.

The main theme of the book is, indeed, a plea for a true cultural synthesis as the best help for the present and the most hopeful prospect for the future. The unity of mankind, as it emerges from a study of the development of civilisation in all its aspects, is the lesson the teacher should strive to impart; and though there must be specialists, there should be no specialist unaware of the unity of knowledge and unappreciative of the work of others.

Dr. Sarton is concerned with more than generalities and vague indications of the path to be followed. He supports his thesis with detailed suggestions for educational schemes, and since these are both practicable and most carefully thought out, they demand the serious consideration of everyone who has the intellectual welfare of the race at heart. To humanise knowledge and to integrate it must be the earnest desire of every reflective man; and Dr. Sarton has shown us how that desire might be accomplished. E. J. HOLMYARD.

Short Reviews

Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century. By Dorothea Waley Singer, assisted by Annie Anderson and by Robina Addis. Vol. 3. Pp. iii+757-1179. (Brussels: Union Académique Internationale, 1931.) 15 Belgas.

THE third volume of Mrs. Singer's monumental catalogue of alchemical manuscripts in the British Isles mainly consists of indexes, with corrections and addenda to earlier descriptions. The indexes comprise a list of first lines of every tract described in the catalogue—a feature of the greatest use to students in every country; a list of every person, whether author, scribe, or owner, mentioned in them; and a list of the manuscripts classified under the libraries where they are to be seen, and containing much incidental information concerning them. In brief, nothing has been neglected which could make the work more valuable to those likely to use it, and Mrs. Singer is to be congratulated heartily on so complete a piece of work.

Two sections are prefixed to the book, the first dealing with a curious work known as Kyrannides, just over the border-line between alchemy and magic, the second dealing with legal documents on its history. Of these, one is specially interesting as bearing on a legend preserved by Camden in his "Remaines concerning Britaine", where he says of the first gold noble, coined by Edward III. of pure gold in 1343 or soon after, "which our Alchimists do affirm (as an unwritten verity) was made by projection or multiplication Alchimicale of Raymond Lully in the Tower of London". In 1350, four prisoners were brought into the King's Bench from the Tower. One of them, who had been in prison for seven and a half years, had received 500 écus of gold and twenty pounds of silver from the Treasury to make gold by alchemy. There can be no doubt that this was the foundation of the Lully legend.

Another interesting entry is that of a very strong Royal Commission in 1457 to examine and report on the merits of alchemy and the elixir. Its report has never been found, but it is not impossible that it still lies somewhere in the Record Office. As gold-making was illegal, and continued to be so until 1689, a number of licences to practise the art were granted. The number of manuscripts in fifteenth century English testifies to a wide interest in the subject. It is a curious chapter in the history of science. R. S.

The Physiology of Beauty. By Arthur Sewell. Pp. xiv+194. (London: Kegan Paul and Co., Ltd., 1931.) 8*s*. 6*d*. net.

THE modern mechanist—the 'publicist', to adopt the term used by Prof. Hogben, who contributes an introduction to this book—has never claimed that all the activities of living matter are to-day capable of being 'explained' on physico-chemical lines, or even that they ever will be. But he does hold it to be possible, and even likely, that the behaviour of living organisms will one day be describable in the same terms, by means of the same symbols, and in the light of the same laws as are available to describe the phenomena of the inorganic world.

The possibility of applying to æsthetic responses any methods of analysis comparable with those used in pure science has in general been ridiculed by the anti-mechanists.

To the best of our knowledge, Mr. Sewell is the first to attempt, in anything like a systematic manner, to apply to these responses the ideas of behaviourist philosophy and the concept of the conditioned reflex. He has done so with courage, humour, knowledge, and, so far as the complexity of his subject permitted, remarkable lucidity. Perhaps a disproportionate section of his book is devoted to discussing the "physiology of truth" and the "physiology of good", at the expense of the actual subject promised by his title. This is analysed in Part iv., but with such tantalising brevity that another book in which ethics and epistemology have a relatively much smaller share is much to be hoped for, so that he may further

develop the idea of "biological utility" in æsthetic responses and his purely extrospective technique.

Those who are emotionally anti-mechanist, who have been conditioned against even sympathy with the publicist attitude, will do well to ignore this book. It is difficult to see how they will be able to reply to much of it. But those who realise that their enjoyment of poetry, painting, music, and the other arts will in no wise be impaired by correct analysis of that enjoyment, and who prefer an objective to an introspective analysis, should welcome the publication of Mr. Sewell's book.

A. L. B.

The House of Industry: a New Estate of the Realm. By S. G. Hobson. Pp. xxviii + 113. (London: P. S. King and Son, Ltd., 1931.) 1*s.*

SUPERFICIALLY "The House of Industry" is but another name for the House of Lords, become the chief cornerstone in the logical evolution of the ever-increasing tendency of the House of Commons to turn its economic problems over to independent 'commissions' for solution. Actually it is a British version of the Soviet Central Committee.

In his effort to make the suggestion palatable to a people to whom property rights are regarded as sacred, Mr. Hobson has left several unbridged gaps between the idea and its practical application. The House of Industry is a new name for a metamorphosed House of Lords, but the House of Industry is to be partly selected and partly elected "by groups differently graded in the industrial hierarchy". How are the groups to be graded? Who is to grade them? How will the selection and election be carried out? He does not say; nor how he will ensure the selection and election of men competent to handle economic problems. As to how the peers and people are to be convinced that the elected-selected House of Industry is in apostolic succession to the hereditary House of Lords, he is also vague.

However, concede the House of Industry established: it must be stable, with no interest beyond the needs of industry (including the worker). A selected body might be so—the judiciary is beyond reproach—but can the elected portion ever be free from the influence of its electors? And if so, why elect?

To ensure efficiency, the House of Industry is to be free of the technicalities intended to safeguard democracy, but it is to be subject to the veto of the Commons, which will remain subject to those technicalities.

The idea is interesting. It is ably advocated. But is it sound? One is not yet convinced.

Grundprobleme der Geologie: eine Einführung in geologisches Denken. Von Prof. Serge von Bubnoff. Pp. viii + 237. (Berlin: Gebrüder Borntraeger, 1931.) 11·60 gold marks.

THE flood of German geological literature that began after the War continues to rise so rapidly that many worthy contributions must perforce be given scant attention by geologists to whose special interests they do not immediately refer. It is therefore important to insist upon the outstanding virtues of this short but brilliant book by Prof. von Bubnoff. As a philosophical treatment of the methods and fundamental problems of geology it is unsurpassed, and it is not too much to say that no geologist, be he practitioner, teacher, or advanced student, could fail to profit from a careful reading of this stimulating, clearly expressed, and fair-minded survey of his subject.

Prof. Bubnoff's style is lucid and his vocabulary can be quickly mastered; his German presents no terrors and need not deter even those who usually struggle along with difficulty. The book will richly repay a sustained effort to master its contents. The first part deals with the epistemological basis of geology; the second with the interpretation of the rocky pages of the earth's long history; the third with the measurement of geological time; the fourth with the tectonic conceptions embodied in such terms as shields, stable shelves and mobile shelves, and geosynclines; and the fifth with the structure of the earth and its crustal movements. The present state of our knowledge of sedimentation, igneous activity, metamorphism, mountain-building, isostasy, and continental drift is expressed with admirable detachment from particular doctrines. Modern theories are ably discussed and critically analysed with equal emphasis on their successes and failures. There is a tendency to favour internal mobility as the cause of crustal movements on the lines suggested by Ampferer and Schwinner on the Continent and by Bull and Holmes in Great Britain, but with a cool recognition that the problems involved are still far from being satisfactorily solved.

The book is of quite unique value. Nothing like it in scope and temper has hitherto appeared, and an English translation would undoubtedly be very widely welcomed.

The Genesis of Cancer. By W. Sampson Handley. (The Anglo-French Library of Medical and Biological Science.) Pp. xix + 258 + 88 plates. (London: Kegan Paul and Co., Ltd., 1931.) 21*s.* net.

MR. SAMPSON HANDLEY draws his data from the experiences of a curious and progressive practical surgeon, and is concerned to define the anatomical conditions which underlie the beginnings of cancers. He finds that the feature which is common to all precancerous states is an inflammation of the smaller and mostly terminal lymphatics, leading to lymph stasis, and he upholds his thesis by the detailed histology of a considerable variety of lesions—warts and adenomata, lupus and its malignant development, chronic mastitis, skin irritation in general, especially dermatoses from tar and oil, X-rays, and radium.

The changes in the connective tissue which Mr. Handley describes are, of course, well known: he differs from most other observers in judging that they precede rather than follow cancer, and adduces much striking evidence in favour of his contention. Why exactly chronic lymph stasis should lead to cancer, he does not explain: at the moment, it is scarcely reasonable to expect him to do so.

The Expanding Universe*

By Sir ARTHUR EDDINGTON, F.R.S.

IN recent years the line-of-sight velocities of about ninety of the spiral nebulæ have been measured. The distances of some of the nearest of them have been determined by a fairly trustworthy method, and for others rude estimates depending on statistical methods are available. When we survey these data, a remarkable state of affairs is revealed. The spiral nebulæ are almost unanimously running away from us; moreover, the greater the distance the greater the speed of recession. The law of increase is found to be fairly regular, the speed being simply proportional to the distance. The progression has been traced up to a distance of more than 100 million light-years, where the recession is 20,000 km. per sec.—about the speed of an α-particle.

At first sight this looks as though the spiral nebulæ had a rather pointed aversion to our society; but a little consideration will show that the phenomenon is merely a uniform dilation of the system and is not specially directed at us. If this room were suddenly to expand to twice its present size, the seats separating in proportion, you would notice that everyone in the room had moved away from *you*. Your neighbour who was 3 feet away has become 6 feet away; the man over yonder who was 20 feet away is now 40 feet away. Each has moved proportionately to his distance from you, which is precisely what the spiral nebulæ are observed to be doing. The motion is not directed from any one centre, but is a general expansion, such that each individual observes every other individual to be receding.

In 1917, before any hint of this phenomenon had been obtained from observation, Prof. W. de Sitter was on the look out for something of the kind. He found that, on one of two alternative hypotheses arising out of Einstein's relativity theory, the light of very remote objects should be displaced to the red as though they were moving away from us; and he suggested the observed motions of the spiral nebulæ (by far the most remote objects known) as a discriminating test. At that time, only three radial velocities had been published, and they rather lamely supported his hypothesis by a majority of 2 to 1. The majority has now become about 85 to 5, and the five exceptions are nebulæ close to us which in any case should have had only small receding velocities. De Sitter's theory has been developed and modified by Friedman and Lemaître; the modern view of it is as follows:

Einstein's law of gravitation contains a term called the 'cosmical term' which is extremely small in ordinary applications to the solar system, etc., and is generally neglected. The term, however, actually represents a repulsive force directly proportional to the distance; so that however small it may be in ordinary applications, if we go to distances sufficiently great it must ultimately become important. It is this cosmical repulsion which is, we believe, the cause of the expansion of the great system of the nebulæ. The repulsion may be to some extent counterbalanced by the ordinary gravitational attraction of the nebulæ on one another. This countervailing attraction will become weaker as the expansion increases and the nebulæ become farther apart. It seems likely that the universe started with a balance between gravitational attraction and cosmical repulsion; this equilibrium state is called an 'Einstein universe'. But it can be shown that the Einstein universe is unstable; and the slightest disturbance will cause either the repulsion or the gravitation to gain the upper hand, so as to topple the system into a state of continually increasing expansion or continually increasing contraction. Apparently, expansion won the initial struggle, and as the nebulæ spread apart, the opposition of gravitation became less and less, until now it is comparatively insignificant.

We see, then, that according to observation the system of the spiral nebulæ is expanding, and that relativity theory had foreseen just such an expansion (except that as an alternative it would have been content with an equally regular contraction). What better agreement could we desire? Nevertheless, there were some misgivings which I would not by any means condemn as unreasonable. It is true that theory predicted an effect of the kind observed, but it did not say how rapid the expansion would be. It expressed it in terms of an unknown 'cosmical constant' λ, leaving λ to be determined by observation. Now the rate of expansion indicated by observation comes to us as a great shock. The universe is expanding so as to double its dimensions every 1300 million years; that is no more than the period of geological time. Astronomers, who had been picturing a slow evolution of the stars extending over billions of years, would scarcely believe our staid old universe capable of such a hustle. In fact, it means a cut of something like ninety-nine per cent in our time-scale, which even in these days of economy cuts is not to be accepted lightly by the department concerned. For this reason many have thought that the receding motions of the spiral nebulæ cannot be accepted as genuine, and that the whole phenomenon must be explained away as a misinterpretation of the red-shift observed in their spectra.

I think, however, that we shall have to accept the expansion. My reason is that it now seems possible to calculate the cosmical constant λ by pure physical theory. The value is the same as that given by the recession of the nebulæ, so that there is full confirmation.

I have been tracing the effects of the cosmical constant in the behaviour of the great system of galaxies—phenomena on the grandest scale we

* Friday evening discourse delivered at the Royal Institution on Jan. 22.

have yet imagined. Now I want to turn to the other end of the scale and look into the interior of the atom, where, I think, we shall find that the same cosmical constant turns up again. It is, in fact, the main key to the mystery of protons and electrons. I cannot go very far into this part of the theory, but I will try to show why I am convinced that the cosmical constant comes into the theory of the atom. I must premise one thing. It is well known that, in Einstein's theory, gravitation has an interpretation not only as a force but also as a geometrical property — a curvature — of space-time. So also the cosmical constant has an interpretation not only in terms of repulsive force but also as a measure of curvature. The constant λ is, in fact, precisely equal to $1/R^2$, R being the radius of the world in the equilibrium (Einstein) state from which we suppose it to have started.

Length is necessarily relative. That is one of the results of Einstein's theory which has become almost a commonplace of physics; but it was a rather complicated kind of relativity that Einstein considered—relativity to the motion of our frame of reference. I am going to refer to another much more elementary relativity of length, namely, that length always implies comparison with a standard of length. It is only the ratio of lengths that enters into our experience. Suppose that every length and every distance in the universe were suddenly to be doubled; nothing would seem altered. I do not think we could attach any meaning to the change. Intrinsically, Brobdingnag and Lilliput are precisely the same; it needs an intruding Gulliver—an extraneous standard of length—to make them appear different.

Now, it is commonly stated in physics that all normal hydrogen atoms have the same size, or have the same spread of electric charge. We have a very fundamental equation (the wave equation) determining the spread, which is supposed to apply to any hydrogen atom and, of course, gives the same result for all. But what do we mean by their having the same size? Or it may be better to put the question negatively—What would it mean if we said that two hydrogen atoms were of different sizes, that is, similarly constructed but on different scales? It would be Brobdingnag and Lilliput over again. To give any meaning to the difference, we need a Gulliver. Now, the Gulliver of physics is always supposed to be a certain bar of metal called the International Metre. He is anything but a traveller; I think he has never been away from Paris. It was Prof. Weyl who first directed attention to the very big hiatus involved, when we speak of a length such as the radius of a hydrogen atom being a certain fraction of the standard metre. We have, as it were, our Gulliver but have left out his travels. The travels are (as Weyl showed) the interesting part of the story, and are not to be glossed over as irrelevant.

Weyl went further and pointed out that there is a natural standard of comparison which is always on the spot, namely, the radius of curvature of the world *at that spot*. We can thus give a direct meaning to the statement that two hydrogen atoms in any part of the universe have the same size; we mean that each of them is the same fraction of the radius of curvature of space-time at the place where it lies. The atom here is a particular fraction of the radius of curvature here; the atom on Sirius is the same fraction of the radius of curvature at Sirius. Whether the radius of curvature here is the same as at Sirius does not arise, and I do not think there is any meaning in trying to compare them.

The above definition of equality, and the use of Weyl's standard, may seem a dangerous innovation; but, indirectly, we have been using it all along, without knowing that we were doing so. Some years ago I pointed out that Einstein's law of gravitation can be stated in the form, "What we call a metre at any place and in any direction is a constant fraction of the radius of curvature of space-time for that place and direction". That is simply a translation of the law from symbols into words. The law is verified by observation, so that the statement gives us not only an ideal definition of the metre but also one which we know will accord with the reckoning of metres that is actually used. Thus, measurement in terms of the metre is equivalent to measurement in terms of the world radius, since the two standards are always in a constant ratio. Practically, it is more convenient to employ the metre, but in pursuing the theory we must go direct to the world radius; for obviously a particular bar of metal at Paris can have no fundamental status in physics and is altogether irrelevant to equations describing the mechanism of the atom. The world curvature, on the other hand, is on the spot and is directly reacting with the atom.

I now return to the wave equation which professes to determine how large an atom will be. That, as we have seen, means that it finds the ratio of the various intervals in the atom to the world radius there; so the world radius must come into the equation. But the world radius is the cosmical constant in another form. The cosmical constant has cropped up again inside the atom.

My task now was to spot the cosmical constant or the world radius in the current form of the wave equation, which is known by experiment to be substantially correct. It is very much disguised, because the current equation introduces the standard metre and all sorts of irrelevancies. But one knows the sort of effect that curvature can have; and the way it will appear in the equation is pretty well dictated by the quantum laws, which make a speciality of the properties of 'closed circuits' such as are introduced by curved space. I think I succeeded, and I arrived at the identification

$$mc^2/e^2 = \sqrt{N}/R.$$

The left side is a term in the current wave equation, and its value is known experimentally. The right side is the way that we write it now that we have penetrated its disguise. R is the Einstein radius of the world, equal to the inverse square root of the cosmical constant; N is the number of electrons (or protons) in the universe.

This additional equation, combined with other equations already known, gives all the information required. We deduce, for example, that the number of electrons in the universe is $1{\cdot}29 \times 10^{79}$; and that the original radius of the universe, before it started to expand, was 1070 million light-years. Most important of all, we find that the consequent rate of expansion of the universe is 528 km. per sec. per megaparsec distance. The observational determinations from the recession of the spiral nebulæ (which might be a little lower, since they include any countervailing gravitational attraction) range from 430 km. to 550 km. per sec. per megaparsec. We can feel little doubt, therefore, that the observed motions of the nebulæ are genuine and represent the expansion effect predicted by relativity. We must reconcile ourselves to this alarming rate of expansion, which plays havoc with older ideas as to the time-scale.

However interesting may be the application of this theory to the universe, the application to the interior of the atom seems likely to be still more fruitful. Now that we know the magnitude of the radius of curvature, we can set aside the arbitrary metre and use this natural unit in our equations. The big uninformative coefficients disappear; and the equations are so much simplified that, I think, I have a fair idea of what they really mean and how they work. In particular, the relation of the proton to the electron is now apparent, and the theoretical ratio of their masses is found to be 1847·6; this is certainly very near to the observed value.

I do not want to stress too much the accuracy or finality of these first results. I cannot see how anything can possibly be wrong with them; but then one never does see these faults until some new circumstance arises or some ingenious person comes forward to show us how blind we have been. At least, a way of progress has been found. I think that some day, when electrons and protons have come to order, we shall look back and see that the key to the mystery was lying somewhere in intergalactic space and was picked up by astronomers who measured the velocities and distances of nebulæ ten million light-years away.

Goethe as Biologist

By Prof. F. J. COLE, F.R.S., University of Reading

THE celebration of the centenary of the death of Goethe, which occurred on March 22, 1832, has evoked a series of works dealing with the activities of that unique genius. Among them is a critical biography by Prof. J. G. Robertson, the eminent authority on the life and works of Goethe.* This treatise is outside the scope, but not indeed outside the interests, of a scientific journal such as NATURE, except for the fact that it includes an enlightening chapter on Goethe's contributions to science. As a matter of personal history Prof. Robertson can scarcely be expected to take other than a detached view of Goethe's scientific achievements, and it is therefore not surprising to find him stating that "we look to Goethe, not for scientific discovery, an activity with which many other minds were as able—and perhaps better able—to cope successfully, but to more precious discoveries in the realm of the spirit and the imagination. May we not thus cherish something of a grudge that his immersion in scientific pursuits took up so very large a share in his life?" Prof. Robertson, however, would be the first to admit that Goethe himself would have indignantly denounced such an attitude, which strikes at the root of one of his characteristic speculations as to the nature of creative art. To him the living organism was a work of art which only an artist could be expected to comprehend. Further, it is precisely those attributes of the spirit and imagination which give to his scientific work the qualities we all find so fascinating.

It was in an essay written in 1795, but not published until 1820, that Goethe focused attention on the unity of plan or organic constant which was supposed to underlie the organisation of all living beings. Since there was only one plan or idea, the world was regarded as something akin to a vast musical symposium, in which the poverty of a solitary theme was enriched by an endless and expanding series of variations. All forms were interpreted in terms of this ideal simulacrum,† and even man himself must be studied comparatively, working downwards from higher to lower types. This is the so-called law of reduction, or, to paraphrase the words of Geoffroy—there is but a single intangible being which becomes patent to our senses under diverse forms. Goethe was, of course, not the first to adopt such an attitude, but he was the first to convert it into an ordered scientific theory. The plan was put into operation or integrated by a controlling dynamic principle or *Bildungstrieb*. It is obvious at the outset that the theory is a scheme of development and not a principle of evolution, and, further, that its working out must depend on the institution of a system of homologies. There is one attractive feature in this point of view. However wrong it may be, it attempts to provide a common explanation of organic phenomena, and does not countenance the artificial separation of animals and plants.

Goethe's eager pursuit of homologies, of uniformity in diversity, was bound to lead to the conception that there was only one animal. Not merely was there a single animal type, but the integration of the type itself was effected by linking up into a series a number of similar, complete, subordinate entities like a string of beads. He extended the same speculation to plants, and interpreted, as others had done before him, the

* "The Life and Work of Goethe, 1749–1832." By Prof. J. G. Robertson. Pp. xii+350+8 plates. (London: George Routledge and Sons, Ltd., 1932.) 12*s.* 6*d.* net.

† Goethe would not have approved this term, but the 'reality' of the idea is that of a mental abstraction projected on to paper like Owen's Archetype.

leaves, sepals, petals, stamens, and pistils as variants of a common structure, just as the skull of the animal represented the efflorescence of the vertebral column. Leaf and vertebra were the elemental structures of animal and plant. He was not unmindful of the fact that modifications of the plan cannot be introduced without affecting the status of the whole, and his law of balance, that "in order to spend on one side, Nature is forced to economise on the other side", is closely related to the famous deduction made by Cuvier in 1812 of the law of correlation, which was exploited with such dramatic effect by himself and later comparative anatomists. Goethe was not the only biologist to become obsessed with this idealistic morphology. Even Johannes Müller himself embodied it in his "Inaugural Dissertation"—a lapse which this sensitive man lamented so deeply in later years that he bought up and destroyed all copies of the offending thesis.

It is not difficult to understand why Haeckel should have been led to credit Goethe with a share in the triumph of evolution, and to regard him as a forerunner of Darwin. Both Haeckel and Goethe were convinced upholders of the comparative method, and Haeckel was powerfully influenced by the genius of the poet. In Goethe's work on the metamorphosis of plants published in 1790, which is considered to be the beginning of speculative morphology,* there are passages which give some support to the claim. Everything depends on his interpretation of what is called 'metamorphosis'. Is it an objective historical reality, as any principle of organic evolution is considered to be, or is it a philosophical conception expressing nothing more than the realisation of a generalised subjective plan or idea, which itself is not inconsistent with Nature philosophy and special creation? He hesitates between these alternatives, nor does it appear that they were ever sharply contrasted in his own mind, and he has no consistent views with regard to either. His contemporaries included him among the Nature philosophers, and Goethe, who did not hesitate to express the liveliest dissatisfaction when his scientific works were misunderstood, never thought it worth while to correct them. In his later writings, however, he appears at times to have a clearer perception of the evolutionary alternative, but again, at the close of his life, in 1830, he was supporting Geoffroy in his contest with Cuvier, which shows how far he was from comprehending the historical implications of evolution. There is no evidence that he ever specifically discussed the problem of species, regarding such speculations as "a useless occupation which we may well leave to those who are fond of busying themselves with insoluble problems" (Robertson).

The main point of contact between Goethe and Haeckel lies, however, in the fact that the evolutionist, like the Nature philosopher, also expects to find uniformity in diversity, but he only looks for it where it may reasonably be expected to exist, nor is he in any way constrained to mould the facts or stretch the argument in those cases where the quest has been unsuccessful. Failure must not only be expected but also accepted, since it does not affect the essential truth of the principle of evolution, but merely its mode of operation. Whilst, therefore, Goethe's methods were up to a point those approved by Haeckel and the evolutionists, he goes, and must go, considerably beyond the permitted limits of scientific induction. Having *assumed* the existence of a single animal type, it follows that, unless evidence for such a type be forthcoming, every species must be manipulated to conform to it. Such was the error of Goethe and his successors the Nature philosophers, and it must be held definitely to exclude them from the evolutionary circle, although Goethe himself was never guilty of the ludicrous extravagances of his disciples. In one cardinal respect, however, he was remarkably sound. He saw that purely morphological speculation was as dust and ashes in the mouth compared with the vision of the form and activities of an animal as a living organic whole. Or in other words, the *complete* organism only can give us understanding of its inner meaning or idea.

The attitude adopted by Goethe towards the question of animal relationships may be profitably explored by a comparison of his two researches on the intermaxillary bone and the vertebral theory of the skull. The former was written up in 1784 and bears the date of 1786 (*sic*),† but it was not published until 1831, although an abstract without illustrations appeared in 1817. The latter paper was drafted and communicated to friends in 1790, but was actually published in 1820, this belated publication being responsible for the priority dispute with Oken. The alleged absence of the premaxilla in man was considered to separate him definitely from the apes—a conclusion which ignored the fact that if the bone is absent in man it is also wanting in the higher apes. Goethe sought to establish its presence in man by methods not dissimilar from those of the modern comparative anatomist. He examined its condition in a number of mammals, noted variations in its state of development and correlated them with feeding habits, investigated aberrant cases such as that of the elephant, and succeeded in finding the bone in some species in which it had not been described. Finally, by comparing human adult and fœtal skulls, he demonstrated its presence in man.‡ He thus established the importance of embryology in the intepretation of adult structure. His work, in fact, is an admirable essay in comparative anatomy.

The research on the skull, however, belongs to another category. It has no concern with experience, but is an exploitation of the Idea. Whether the skull is vertebral in nature or not, cannot be tested by observation. If, however, we concede the point, the skull may have been formed on the

* Goethe introduced the term morphology in 1817, but his definition of it is not retained in modern usage.

† This date is usually but erroneously quoted as the date of publication.

‡ The bone was not first discovered in man by Goethe. Vesalius and Fallopius saw indications of it in 1543 and 1561, and Vicq D'Azyr described it in the human fœtus in 1780–84.

vertebral pattern as the result of the operation of a creative force working according to plan, or it may have been produced from modified vertebræ by a process of evolution. In either event, the investigator is confronted with an abstraction beyond the means of verification. It is otherwise with the case of the intermaxillary bone. Here the 'metamorphosis' may be tested and observed in all its stages, and an evolutionary conclusion becomes not only possible but almost inevitable. But how did Goethe regard these two problems? To him their implications and significance were *identical*, and the only inference he drew from both of them was a confirmation of his theory of the common plan or idea. To such an outlook, deduction and induction are indistinguishable. Had the history of the intermaxillary bone suggested to his mind any conception of genetic relationships, he would surely have said so. Goethe therefore was a forerunner of Darwin only in the sense that before the historical continuity of species could be established it was necessary to formulate a doctrine of homologies, and in this important work Goethe played a leading part.

Not until the end of his life did Goethe exercise any appreciable influence on the biological thought of the period. This was due partly to delays in publication, but particularly to the imaginative and romantic character of his work—a quality rarely grateful to the academic mind. At first his influence was almost wholly reactionary, but the eclipse of Nature philosophy purged his writings of their ephemeral content and made it possible to form a sound judgment of the residue, with results that have only become evident in modern times. That his biological work will always command the respect and admiration of scientific men is a conclusion to which all his critics would assent.

Goethe's Reflections on Nature

WE reproduce below the translation of Goethe's reflections on Nature by T. H. Huxley, which was published as an introductory article to the first number of NATURE, dated Nov. 4, 1869. As originally printed, a casual reader might easily conclude that this lyrical composition was the work of Huxley himself, and in a letter to Dohrn, written shortly afterwards, he says: "It astonishes the British Philistines not a little. When they began to read it they thought it was mine, and that I had suddenly gone mad." Darwin himself was stirred to admiration, and wrote to Hooker as follows: "Lord, what a rhapsody that was of Goethe, but how well translated; it seemed to me, as I told Huxley, as if written by the maddest English scholar. It is poetry, and can I say anything more severe?" Huxley added to his translation some comments upon Goethe's "wonderful rhapsody on Nature which has been a delight to me from my youth up"; and he referred to it in an article entitled "Past and Present", contributed by him to the first issue of our fifty-first volume, on Nov. 1, 1894. In a footnote to this article, Huxley said: "A better translation than mine and an interesting account of the very curious obscurity which hangs about the parentage of *Die Natur* are to be found in Mr. J. Bailey Saunders' recently published 'Goethe's Aphorisms and Reflections'."

NATURE: APHORISMS BY GOETHE *

NATURE! We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her.

Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired and drop from her arms.

She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old.

We live in her midst and know her not. She is incessantly speaking to us, but betrays not her secret. We constantly act upon her, and yet have no power over her.

The one thing she seems to aim at is Individuality; yet she cares nothing for individuals. She is always building up and destroying; but her workshop is inaccessible.

Her life is in her children; but where is the mother? She is the only artist; working-up the most uniform material into utter opposites; arriving, without a trace of effort, at perfection, at the most exact precision, though always veiled under a certain softness.

Each of her works has an essence of its own; each of her phenomena a special characterisation: and yet their diversity is in unity.

She performs a play; we know not whether she sees it herself, and yet she acts for us, the lookers-on.

Incessant life, development, and movement are in her, but she advances not. She changes for ever and ever, and rests not a moment. Quietude is inconceivable to her, and she has laid her curse upon rest. She is firm. Her steps are measured, her exceptions rare, her laws unchangeable.

She has always thought and always thinks; though not as a man, but as Nature. She broods over an all-comprehending idea, which no searching can find out.

Mankind dwell in her and she in them. With all men she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that the game is over before they know it.

That which is most unnatural is still Nature; the stupidest philistinism has a touch of her genius. Whoso cannot see her everywhere, sees her nowhere rightly.

She loves herself, and her innumerable eyes and affections are fixed upon herself. She has divided herself that she may be her own delight. She causes an endless succession of new capacities for enjoyment to spring up, that her insatiable sympathy may be assuaged.

She rejoices in illusion. Whoso destroys it in himself and others, him she punishes with the sternest tyranny. Whoso follows her in faith, him she takes as a child to her bosom.

Her children are numberless. To none is she altogether miserly; but she has her favourites, on whom she squanders much, and for whom she makes great sacrifices. Over greatness she spreads her shield.

She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the road.

* From NATURE, Nov. 4, 1869.

Her mechanism has few springs—but they never wear out, are always active and manifold.

The spectacle of Nature is always new, for she is always renewing the spectators. Life is her most exquisite invention; and death is her expert contrivance to get plenty of life.

She wraps man in darkness, and makes him for ever long for light. She creates him dependent upon the earth, dull and heavy; and yet is always shaking him until he attempts to soar above it.

She creates needs because she loves action. Wondrous! that she produces all this action so easily. Every need is a benefit, swiftly satisfied, swiftly renewed.—Every fresh want is a new source of pleasure, but she soon reaches an equilibrium.

Every instant she commences an immense journey, and every instant she has reached her goal.

She is vanity of vanities; but not to us, to whom she has made herself of the greatest importance. She allows every child to play tricks with her; every fool to have judgment upon her; thousands to walk stupidly over her and see nothing; and takes her pleasure and finds her account in them all.

We obey her laws even when we rebel against them; we work with her even when we desire to work against her.

She makes every gift a benefit by causing us to want it. She delays, that we may desire her; she hastens, that we may not weary of her.

She has neither language nor discourse; but she creates tongues and hearts, by which she feels and speaks.

Her crown is love. Through love alone dare we come near her. She separates all existences, and all tend to intermingle. She has isolated all things in order that all may approach one another. She holds a couple of draughts from the cup of love to be fair payment for the pains of a lifetime.

She is all things. She rewards herself and punishes herself; is her own joy and her own misery. She is rough and tender, lovely and hateful, powerless and omnipotent. She is an eternal present. Past and future are unknown to her. The present is her eternity. She is beneficent. I praise her and all her works. She is silent and wise.

No explanation is wrung from her; no present won from her, which she does not give freely. She is cunning, but for good ends; and it is best not to notice her tricks.

She is complete, but never finished. As she works now, so can she always work. Everyone sees her in his own fashion. She hides under a thousand names and phrases, and is always the same. She has brought me here and will also lead me away. I trust her. She may scold me, but she will not hate her work. It was not I who spoke of her. No! What is false and what is true, she has spoken it all. The fault, the merit, is all hers.

Obituary

Dr. G. Claridge Druce, F.R.S.

THE death on Feb. 29, at Oxford, of Dr. George Claridge Druce removes not only the best-known student of our British flora but also a remarkable personality. The charming story of his early life, which he has given us in the introduction to his "Flora of Buckinghamshire", shows how circumstances worked to shape his life and mould his character. He was born on May 23, 1850. The *res angustae* of his childhood threw him into the arms of Nature for his diversion, and his playthings were the wild flowers around the Northamptonshire village where his widowed mother had made her home. He tells how, by the lack of foresight of his guardian, he was debarred from a public school education, but the individuality which characterised his work through life, his independence, his undaunted persistence in arriving where others would have fallen short, may perhaps be traced to the less rigid training of his early years. In the woodlands near his home he studied the insect life as well as the plants, and by the age of fourteen had made a very representative collection of the local Lepidoptera; pupæ were dug for and larvæ bred, and plants were fixed in the memory by making carbon impressions of the leaves. Holidays spent in different localities in Bedfordshire on the greensand and chalk enlarged his knowledge of the flora and insect life.

At fifteen Druce was apprenticed to a large wholesale and retail chemist's business in Northampton, and two years later became acting-manager. The long business hours left little time for field-work, much of which was done by rising at 5.30 or 6 A.M. During the years that followed, without tutorial aid, he studied for and passed with honours the examinations for a pharmaceutical chemist. A herbarium was indicated as part of the equipment of a pharmacist; in 1873 one was begun, and in the first year he collected about 750 species. He was now definitely working on the preparation of a "Flora of Northamptonshire", which was printed in 1879 in the *Journal of the Northamptonshire Natural History Society*, of which he was one of the founders and had also acted as honorary secretary and president. His last important piece of work was a much enlarged and fuller "Flora" of his native county, published in 1930.

In 1879 Druce bought, with his savings, the pharmacy in High Street, Oxford, where he remained in business for the rest of his life. Prominent landmarks of subsequent years are the "Floras" of the Thames valley counties, at which he worked successively—Oxfordshire (1886), Berkshire (1897), and Buckinghamshire (1926). But the preparation of these county floras by no means represented the sum of his botanical work. No man had so intimate a personal knowledge of the British flora, which had been gained by frequent excursions to all parts of the country. The fact that a 'new' plant had been reported in Skye or some other locality, near or remote, was enough to send him hot-foot in search of it, and the Annual Reports of the Botanical Society and Exchange Club, which, as secretary, he has drawn up since 1904, are replete with new records and critical notes on British plants by himself and other botanists. The Botanical Society of the British Isles, which Druce started in 1908 as an appendage to the Exchange Club to enlist the help of well-wishers as well as of active workers, did

much to popularise British botany. The Report for 1930, issued last August, after his eightieth birthday, is a testimony to his remarkable energy and virility, recording, as it does, excursions to widely distant parts of the British Isles and a visit to Cyprus.

Not the least interesting fact in Druce's career was his association with the University of the city in which he had his business. Oxford accepted him and honoured him. A botanist visiting a University official (not on the science side) was asked, "You know *our* botanist—Mr. Druce?" In 1895 he was appointed Curator of the Fielding Herbarium and attached to Magdalen College with an honorary M.A. degree. Many years later he was awarded the D.Sc. In association with the professor of botany, Dr. S. H. Vines, he published accounts of two of the historic Oxford Herbaria, the Dillenian in 1907, and the Morisonian in 1919.

Druce's botanical travels were not confined to the British Isles. He had a good personal acquaintance with the European flora, especially of the Mediterranean area. In 1914 he was in Australia with the British Association, and he had also visited South America.

Druce was a good citizen—a member of the City Council, sheriff (1897), and mayor (1900). He had also served as president of the British Pharmaceutical Conference. Writers in the public press have borne testimony to his unsparing readiness to advise and help students of the British flora, however humble, and his wide circle of friends and the remarkable response to the memorial presented on his eightieth birthday testified to the esteem and affection in which he was held. Druce had his foibles. He dearly loved a title. He did not scruple to strain a point to enable him to write *mihi* after a plant-name. His handwriting was execrable: a regrettable and life-long quarrel arose partly from an honest but unsuccessful attempt by an editor to transliterate a botanical communication from him. He had the true collector's spirit—the impulse to get in first.

A remarkable man, Druce has made a noteworthy contribution to British botany by his personal influence, by his published floristic works, and by the rich herbarium and library which he has left with his house and an endowment as a Botanical Institute for the use of botanists. His election to the fellowship of the Royal Society in 1927 was a graceful and appropriate recognition of his work.

A. B. RENDLE.

WE regret to announce the following deaths:

Prof. Alexander Dougall Blackader, emeritus professor of therapeutics and pharmacology in McGill University, Montreal, past president of the Canadian Medical Association, on March 14, aged eighty-five years.

Prof. D. H. Marshall, emeritus professor of mathematics and physics in Queen's University, Kingston, Ontario, on March 14, aged eighty-four years.

Prof. Giuseppe Martinelli, assistant secretary of the Pontifical Academy of Science, Vatican City, and assistant in the Royal Central Office of Meteorology and Geophysics, Rome, aged fifty-four years.

Prof. Henry J. Priestley, professor of mathematics in the University of Queensland, Brisbane, on Feb. 26, aged forty-eight years.

News and Views

John Hunter

MR. WILFRED TROTTER gave the Hunterian Oration at the Royal College of Surgeons on Feb. 15, and his oration stands out among the long series as remarkable for the amount of interesting chronological analogies and psychological questioning which he has managed to compress into twelve pages. His best point is bringing out the fact that Hunter achieved his results, making modern, in fact, the practice of surgery, at a time when most of the discoveries of science on which we now rely had still to come. During his life, 1728–93, the biologist could look for little help from the sciences of the inorganic. The work of Cavendish, Priestley, Galvani, Volta, and Lavoisier was still to come. He would have had to wait ten years for Priestley's discovery of oxygen in 1775, and more than sixty for Wöhler's synthesis of urea and the foundation of biochemistry in 1828. Joule's mechanical equivalent of heat came nearly eighty years later. Joseph Jackson Lister's compound microscope was sixty years ahead, and Lister's greater son did not make clear the nature of wound infections until just a century after Hunter. All this enhances enormously the merit of Hunter. He stands out the more clearly as one of those successful practitioners of science, who by untiring work, scrupulous accuracy, and perfect devotion to truth have worked marvels.

Purpose of Commemorations

MR. TROTTER'S remarks, however, on the practice of commemorating the eminent dead, seem to us somewhat to obscure the main point of such commemorations by the curious psychological data which he suggests. There is a Freudian touch about it which, true as it may be genetically, is ontologically now invalid. Because primitive man did sacrifices to appease the 'manes' of the departed and was in actual fear of his ghost, it does not follow that there is any such dread of the reappearance of Hunter. His ghost would, we are sure, have been most cordially welcomed at Mr. Trotter's discourse on Feb. 15. Admiration as well as perfect love casteth out fear. Nor does the ancient practice of partaking of the bodily remains of the dead hero now prompt us to any really analogous act. We commemorate to

instruct ourselves, to inspire others to act in a way similar to that of the men we revere; perhaps, most of all, to impress the fact of the debt of the living to the past. The continuity of primitive savage instincts in the civilised is a plausible but misleading fallacy in psycho-analysis, and at the best a grave exaggeration. However, in Mr. Trotter's address these allusions only add a quaint flavour of romance. We sympathise with him in his hope that the truly great may be recognised in their lifetime, but we would not have this at the cost of diminishing the respect and remembrance of them after their death. The growth of the latter practice is one of the best features of the age, and offers hope that we may be able to combine our vertiginous progress with the continuity of order.

Third Pedler Lecture of the Chemical Society

PROF. L. RUZICKA, of Zürich, delivered the third Pedler Lecture to the Chemical Society on March 10, his subject being "The Life and Work of Otto Wallach". Prof. Wallach, whose outstanding contribution to organic chemistry was his pioneer work on the terpene series, was born in Königsberg on March 27, 1847, the son of a Prussian official. His early education was on classical lines, and in addition he had a lifelong interest in the contemplation of art. In 1867 he began his chemical studies in Göttingen under the direction of Wöhler and his assistants, Fittig and Hübner. In the atmosphere of industry which was there cultivated, Wallach obtained his doctor's degree after five semesters of study, his dissertation dealing with position isomerism in the toluene series. After a short period in Berlin as assistant to Wichelhaus, he accepted in 1870 an assistantship at Bonn, offered to him by Kekulé. The period at Bonn, which lasted for nineteen years, was interrupted for a short time when he went to Berlin as the sole chemist to a newly founded enterprise which later developed under the name "Aktiengesellschaft für Anilinfabrikation" (Agfa). In 1889 Wallach was called to Göttingen as successor to Victor Meyer, and retained the direction of the Chemical Institute until 1915. In 1908 he was elected an honorary member of the Chemical Society, and in 1909 received an honorary doctorate of the University of Manchester. The Nobel prize for chemistry was awarded to him in 1910. Wallach died on Feb. 26, 1931, having made such contribution to organic chemistry that any attempt to picture the science with Wallach's work removed would unmistakably disclose a severe gap.

Wallach's Chemical Investigations

PROF. RUZICKA gave a brief sketch of the principal investigations conducted by Wallach in the domain of terpene chemistry. The work originated in a study of several samples of essential oils which had been kept untouched for fifteen years in a cupboard in Kekulé's private laboratory. It soon became evident that "a great many terpenes formerly designated differently and of supposedly varying constitution are undoubtedly identical". In the first stages several simple reagents were caused to act on the separate fractions of natural terpene mixtures with the view of the separation of crystalline reaction products. In three years Wallach was able to list eight terpenes which obviously differed from one another, each being characterised without ambiguity: pinene, camphene, limonene, dipentene, sylvestrene, terpinolene, terpinene, and phellandrene. Later it appeared that dipentene is *dl*-limonene, and that pinene, terpinene, and phellandrene are mixtures of α- and β-compounds; moreover, it is now known that sylvestrene does not occur in Nature. Wallach also investigated oxygenated terpene derivatives and the sesquiterpenes, particularly cadinene and caryophyllene. After characterisation of the individual terpenes, he considered the elucidation of their innumerable mutual relations to be more important than the determination of their constitution. The real harvest from the persistent work of Wallach was reaped in 1895, when, with a single stroke, the structure of an entire series of terpene compounds was elucidated. With the end, about this time, of the heroic period in terpene chemistry, Wallach ceased to play the part of pioneer. Of his later work, Prof. Ruzicka referred to that on bicyclic representatives of the terpene series, and that concerned with simple alicyclic compounds.

Early History of Magnetism

AT a meeting of the Newcomen Society held at the British Industries Fair, Birmingham, on March 2, Dr. J. B. Kramer read a paper on "The Early History of Magnetism", in which he discussed the various accounts of the first discovery of a magnet, and the development of the science of magnetism down to A.D. 1600. His remarks were divided into five sections, the first dealing with the discovery of magnetism up to and including the writings of Lucretius, about 95–52 B.C.; the second with the interpretations and first applications of magnetism up to the thirteenth century; the third with the experimental researches of Peter Peregrinus of Marincourt, A.D. 1269; the fourth with the magnetic compass, between the thirteenth and sixteenth centuries; and the last with the discovery of terrestrial magnetism by Gilbert, and with Gilbert's book, "De Magnete".

Discovery of Magnetic Properties

FOR the claim that is sometimes made that the magnet was first known to the Chinese, Dr. Kramer finds no support, but after examining the works of Aristotle and others, he comes to the conclusion that the magnet was discovered accidentally by one of the Grecian tribes who originally inhabited Thessaly and were called Magnetes. The discovery was made in one of the settlements in Asia Minor, in the Province of Lydia, about 600 B.C. That magnets attract through a distance, that they induce magnetism in iron, and that they repel as well as attract, are mentioned by Lucretius. Who made the great discovery that if allowed to move freely a magnet pointed north and south is not known, but Peter Peregrinus describes the dual polarity of magnets. The work of Gilbert was based on 199 'magnetical

experiments', and his greatest original contribution to science was his magnificent discovery and proof that the earth is a colossal natural magnet in itself. Dr. Kramer's paper contains many extracts from the various writers on magnetism, and should prove of wide interest.

Goethe's Scientific Works

A SPECIAL issue of the Berlin journal, *Forschungen und Fortschritte*, dated March 1932, includes thirty-nine pages devoted to a series of articles by more than thirty authorities dealing chiefly with Goethe's influence as a man of science. The subjects covered include mathematics, the theory of colours and optics, chemistry, geology, meteorology, botany, zoology, and anatomy, together with an appreciation of the Goethe Museum at Frankfurt. In the restricted space at the disposal of each author, it has only been possible to deal very briefly with what are often abstruse and involved matters of history, but, nevertheless, these articles should prove a very useful guide to those who propose to take up the study of Goethe's scientific works. The modern critic of Goethe's central idea of the unity of plan has little to add to Schiller's acute observation of 1794, quoted by Prof. O. Abel—"Das ist keine Erfahrung, das ist eine Idee", and Goethe's response—"Das kann mir sehr lieb sein, dass ich Ideen habe, ohne es zu wissen, und sie sogar mit eigenen Augen sehe", is an admirable epitome of his own attitude towards the central idea.

Source of 'Nagana' in South Africa

DR. E. WARREN, director of the Natal Museum, has reported, according to a message in the *Times* of March 10, that experiments carried out by Mr. Davidson, an independent naturalist, "completely destroy the theory at present accepted about the reservoir of infection from which the tsetse fly transmits the widespread cattle disease known as Nagana". It is generally accepted—and has, in fact, been repeatedly proved—that the blood of game animals harbours trypanosomes which, when conveyed to domestic animals by the tsetse fly, give rise to the serious and often fatal diseases which are grouped under the term 'nagana'. Mr. Davidson now claims to have shown that the trypanosome responsible is derived from the latex of certain plants "on which the tsetse fly normally feeds". Further information on these observations (which appear to have satisfied Dr. Warren, by whom they have been "carefully checked") will be awaited with much interest. It is well known that leptomonad-like flagellates are common in the latex of *Euphorbia* and other plants, being transmitted from one plant to another by certain plant-sucking bugs; but no evidence has as yet been published that these organisms can cause disease in vertebrates; and up to the present time no trypanosome has ever been discovered in a plant. The tsetse fly has occasionally been observed to plunge its proboscis into certain fruits, but in the past it has seemed very doubtful if these constitute a regular source of food supply.

Chester Roman Amphitheatre Appeal

DETERMINED efforts are to be made to save the Roman amphitheatre at Chester, which is threatened by the proposal to construct a by-pass road that, on the lines contemplated at present, would pass through the centre of the arena. The Council of the Chester and North Wales Archæological Society has issued a statement in which it is pointed out that even if the road could be constructed without damage to the remains, which is doubtful, it would put excavation in the future out of the question, while it is inevitable that the northern area adjoining the road would be developed for building purposes, and also made inaccessible. The Office of Works, which has been approached in the matter, views with approval the scheme to save the amphitheatre, which is the most considerable in Great Britain. The Office of Works would itself undertake the cost of excavation and be responsible for the future maintenance of the monument if the site was placed in its keeping. The cost of diverting the by-pass road to avoid the amphitheatre is estimated at a sum of £8000. The Council of the Archæological Society, therefore, appeals to the people of Chester, and of Great Britain, for a sum sufficient to enable this monument to be preserved. A stay of three months has been granted to afford an opportunity for the amount required to be raised.

Metallurgical Literature

THE annual general meeting of the Institute of Metals was held on March 9 and 10, and the incoming president, Sir Henry Fowler, delivered his address on the first day. Referring to the literature of metallurgy forty years ago, Sir Henry remarked that it was very meagre in Great Britain, especially as regards non-ferrous metals; and that possibly this lack was in part responsible for the formation of the Institute of Metals, for among its original objects was the publication of a journal containing original papers and abstracts. Abstracts appeared for the first time in the second volume of the *Journal* of the Institute, occupying 41 pages. In the last issue of the *Journal* in which they were incorporated, they occupied (with index) 436 pages. Now that the *Journal* is being published monthly, it is hoped that abstracts will be available within six weeks of the original publication of important papers. Sir Henry stated that more than a thousand periodicals, in about twenty languages, are searched systematically by a band of more than thirty qualified abstractors, who provided in the past twelve months more than four thousand abstracts. The magnitude of this undertaking is probably unique as the work of a single institution.

Practical Applications of Fundamental Research

SIR HENRY FOWLER went on to speak of the importance of fundamental research and of the 'marrying-up' of research with its practical applications. There is nowadays unquestionably much better understanding between the research worker in metallurgy and the practical engineer, due to the

increased facilities for metallurgical education and to the growing importance of metallurgy. Difficulties are still met, however, when the research worker neglects to express himself simply and intelligibly, or the practical man may be unduly conservative as regards new ideas. Sir Henry quoted one example from his own experience in which prejudice was likely to obstruct the application of research in practice. In 1922 he heard incidentally that a small percentage of copper increased the corrosion-resisting properties of steel. Owing to the story, apparently, that if a puddler wished to get a fellow-worker into trouble, he threw a penny into the puddling furnace, it was difficult to get the material made. Finally, Sir Robert Hadfield accepted the order for a small cast of 'copper-bearing steel'. The metal was required for the smoke-box and ash-pan plates of locomotives, and it took a further six or seven years to show that better results were obtained than with ordinary steel, thus emphasising another point, that the practical test of a discovery should be started as quickly as possible without awaiting its full development. The research associations are invaluable in bringing together those directly engaged in industry and those conducting research.

Land Utilisation Survey

THE Land Utilisation Survey of Britain organised by the London School of Economics and the Geographical Association, under the direction of Dr. L. Dudley Stamp, reports considerable progress during its first year. A general report on the work is given in the *Bulletin* of the Survey for February. After fifteen months' work, four counties in England and one in Scotland are completely finished and another eight counties are on the verge of completion. Of the 22,000 quarter-sheets of the 6-inch map of Great Britain, 3670 have been finished. This is good progress, when it is borne in mind that the work had to be organised from the start in every county and is entirely on a voluntary basis. The completed sheets are being reduced to a 1-inch scale, and will then be printed in seven colours and issued by the Ordnance Survey. The numbering of these sheets will be on the basis of the popular edition of the 1-inch map. Sheet 114 (Windsor) is to be produced as an experimental sheet. While work is proceeding rapidly, in parts of the country, particularly in some of the counties of northern England, there are several areas in which little has yet been done. These blank areas include Gloucestershire, Essex, Huntingdon, several Welsh counties, the North Riding of Yorkshire, much of Northumberland, south-west Scotland, and large areas in the central and western Highlands. For these and other regions workers are still required.

Natural History in Church Records

IT is strange from what odd quarters knowledge about the history of animal life may be gathered. This was apparently also the opinion of the vicar of Ridge, who refused permission to examine his parish books, on the ground that he found it difficult to conceive that payments for 'vermin' by parish authorities could be of interest to anyone. Fortunately no other refusal was met by Charles Oldham, and the results of his searches amongst churchwardens' records in Hertfordshire are some odd contributions to the history of vermin (*Trans. Hertfords. Nat. Hist. Soc.*, vol. 19, pt. 2; 1931). Sparrows, which had increased enormously in numbers because of the intensive cultivation of cereals, had a price upon their heads, and a record (Aldbury) of 1720 reads, "Pd for 6 Doz. of Sparrows heads . . . 1*s.*"; and yet, at the same period, others were deliberately encouraging sparrows to multiply by setting up for their use curious receptacles, 'sparrow-pots', from which the young sparrows were taken for food. The most telling of all the records are those relating to the prices paid for the destruction of polecats. In 1721, at Chipping Barnet, 4*d.* was paid for two, in 1723 "for 4 Polecatt . . . 4*s.*" was paid at East Barnet; these records, giving the extreme range of prices, indicate a common and almost worthless creature, and contrast with the demand in Scotland, where at one stage the price of a furrier's dozen of polecats reached 45*s.* Long before that time, in the mid-nineteenth century, when fur value of the polecat had made its pelt desirable, the polecats of Hertfordshire had been exterminated as 'vermin'.

Irish Forests

THE opinion was widely held amongst Irish and English historians of the eighteenth and nineteenth centuries that Ireland was densely wooded down to the last five hundred years, and that the disappearance of the native forests was chiefly due to their exploitation by English adventurers, and the effects of the wars and disturbances during Elizabethan and Cromwellian times. According to A. C. Forbes in his paper on "Some Legendary and Historical References to Irish Forests and their Significance", read before the Royal Irish Academy on Feb. 22, a review of the various authors who were responsible for this conclusion has shown that none can be considered sufficiently acquainted with Ireland to have been an authority on the subject. State papers and other documents indicate that the arrival of the Normans in the twelfth century found Ireland much as it is to-day. A point of considerable interest is the exact position of forest land under the forest laws of the Normans. This forest land was the waste or unenclosed portion of the country, and had no direct connexion with woods or timber trees. Two Irish deafforestation charters of the thirteenth century are in existence, but no record can be found of any proceeding for creating a forest, and Mr. Forbes advanced the theory that the wastes of both Ireland and England were normally afforested or subject to forest laws at a remote period, and that these laws were gradually removed by deafforestation, for which money payments were frequently made to the Crown. Manwood's "Lawes of the Forest" is a doubtful guide on this subject. A further point of interest is the existence of *Pinus sylvestris* in the Irish flora during the historic period. While the pine was a dominant species when the older

bogs were being laid down, its existence as an indigenous tree during the last thousand years is extremely doubtful.

International Federation of Eugenic Organizations

WE have received a copy of the report of the ninth Conference of the International Federation of Eugenic Organizations, edited by the honorary administrative secretary, Mrs. C. B. S. Hodson, and published at 406 Fulham Road, London. The Conference met on Sept. 11-15, 1930, at Farnham, Dorset, and Larmer Tree Grounds, Tollard Royal, Wilts. Associated public meetings were held at the Tithe Barn, Hinton St. Mary, Dorset, at the invitation of Capt. Pitt-Rivers. The first conference, under the chairmanship of Sir Arthur Keith, considered the standardisation of human measurements, with opening papers by Miss M. L. Tildesley on the physical and Miss B. Schieffelin on the mental side. A conference on race crossing, with Dr. Alfred Ploetz in the chair, received contributions from Dr. Mjöen, Prof. C. G. Seligman, Dr. van Herwerden, Prof. Ruggles Gates, Dr. C. B. Davenport, and Prof. Eugen Fischer. At another session international programmes for research in racial psychiatry were presented by Prof. Rüdin, and in racial psychology by Prof. Seligman. An afternoon was devoted to heredity in man, with Prof. Gates in the chair, and contributions by Dr. P. J. Waardenburg, Dr. C. J. Bond, Dr. G. P. Frets, and Dr. Heuyer. The report includes a summary of the discussion on each paper. The last part is devoted to general reports, including a brief statement from twelve countries regarding work on the eugenic or dysgenic effects of the War, and statements concerning recent eugenic work in Czechoslovakia, Finland, South Africa, Holland, Germany, and Austria. Dr. H. H. Laughlin contributes a survey of eugenical work in the United States, Dr. Mjöen one for Norway, and Dr. Schrieber for France. This pamphlet of a hundred pages is a useful summary of work having anthropological and medical as well as eugenical aspects.

Wood Decay in Motor-Cars in the Tropics

THE practical importance of this question is indicated in a brief note in the *Philippine Journal of Science* (vol. 46, No. 2) by C. J. Humphrey, mycologist to the Bureau of Science, Manila. He states that the depreciation of imported automobiles in the tropics from this cause reaches "a staggering figure in proportion to the investment". Most of the cars in the Philippines are American, a few come from Europe; in either case the woods used in their construction are almost exclusively temperate zone species, selected for other properties than their durability. The decay sets in as the result of moisture in the wood, but, under the conditions in the tropics in the rainy season, water almost inevitably penetrates and, in the humid atmosphere, does not easily dry out again. The author states that "six months under test conditions very highly favourable for decay will destroy for all practical use nearly all the temperate zone woods now used in American or European-made cars". Up to the present three species of the higher fungi have been observed fruiting on the rotting wood taken from cars; many more species probably contribute, but most of them are Hymenomycetes. The remedies for the trouble seem clear: either the use of the heartwood of durable species of timber, presumably tropical species, by the manufacturer, or else the non-durable timbers must be adequately treated with a preservative.

Light upon Eggs

ANALYSIS shows that an inverse relation exists between the amount of daylight and the price of hens' eggs in successive months of the year. That in turn is correlated with the amount of food a hen may eat per day, so that the more light, the more food, and, other things being equal, the more eggs. Artificial lighting has been used on a large scale in the United States to shorten the long nights and induce hens to lay more, but it cannot be said to be a common practice in Britain. The results obtained by J. W. Rhys and Raymond T. Parkhurst at the National Institute of Poultry Husbandry suggest, however, that its use might well be extended (*Bull.* No. 6). During the winter months the 120 pullets under lights laid 950 more eggs than an equal number without lights. For the 48 weeks of the test the lighted pen yielded 1086 eggs more than the unlighted pen. The lighted pullets laid an average of 173·5 eggs and the unlighted 161·0 eggs. Financially, the 'morning and evening lights' pen was most successful, the margin of profit over food and lighting costs being 11·58 pence a dozen eggs. Hens apparently give the best results under a 14-hour day.

The First 'Sky-scraper'

A POINT of considerable interest in the history of architecture has just been settled by a joint committee of the American Institute of Architects and the Illinois Society of Architects, which, having watched the demolition of the Home Insurance Building in Chicago, has declared it to be "the first tall structure of metal construction". The essential feature of a 'sky-scraper' is the metal skeleton, defined as "a type of construction in which a metal frame or cage, composed of girders, beams, and columns, supports all internal and external loads and carries all stresses to the foundations". Claims had been set up that the Tacoma Building of 1888 was the first tall metal skeleton building, but the committee states that in the Home Insurance Building there was "a complete skeleton framework, floor loads were carried by both interior and exterior columns, wall loads were transferred to columns, and columns were supported on independent footings". The Home Insurance Building was designed by William Le Baron Jenney and was erected in 1885. It has now been removed to make room for the gigantic Field Building in which 25,000 tons of steel will be used, but it will henceforth have its place in history as the first 'sky-scraper'.

Economic Uses of Beryllium

AMONG the rarer metals which are light in weight and therefore suggest themselves for employment in the aircraft and automobile industries, beryllium

stands out prominently. It is lighter than aluminium and has a much higher melting point than either aluminium or magnesium. In order to provide authoritative information about beryllium and the distribution of deposits of beryl—the only source of which adequate supplies are available—a useful little monograph has been prepared by the Mineral Resources Department of the Imperial Institute ("The Mineral Industry of the British Empire and Foreign Countries—Beryllium (Glucinum) and Beryl", 1931, pp. 26, price 6*d*.). At present the metal is being produced commercially only in Germany and the United States. However, it is clear from the details provided that the British Empire is in a strong position to exploit its resources of beryl if adequate financial help can be found to follow up the preliminary work already accomplished in the field and laboratory. As is usual in this well-known series of monographs on economic minerals, there is a very full bibliography of the leading literature on the subjects dealt with.

National Institute of Industrial Psychology

THE eleventh annual report and the accounts for the year 1931 of the National Institute of Industrial Psychology have recently been published. The development of the Institute's work, in spite of the present financial crisis, continues satisfactorily. There is reported an increase of more than twenty-six per cent in the number of industrial and commercial firms for which the Institute has carried out investigations during the year, and an increase of nearly seventeen per cent in the number of cases examined for vocational guidance. The investigations are concerned with very varied activities, including work in gold mines, gasworks, a fish paste factory, and schools, and the problems investigated include equipment and lay-out of factories, as well as bonus schemes and staff selection. The very valuable work on vocational guidance continues, and while the Institute has acquired knowledge which enables it to advise young people on the choice of a career, yet it is recognised that much remains to be done: research work which will require several years for fruition is in progress. An allied problem, namely, occupational analysis, is also being continued, and studies being made of the abilities required for the various types of women's secretarial work and nursing. Other researches described include the nature and measurement of the mental abilities involved in factory assembly operations, motor drivers' tests, colour discrimination, and a very important investigation into the part played by rhythm in typewriting.

Health of the Army

THE health of the Army, at home and abroad, during 1930 is dealt with in the War Office Report recently issued (H.M. Stationery Office. 2*s*. 6*d*. net). The ratio per 1000 of the strength of men admitted to hospital was 428·4, which is the lowest since the War, with the exception of 1928. Malaria caused 7365 admissions, venereal diseases, 6146, and inflammation of the tonsils, 5519. The principal causes of invaliding from the Army were tuberculosis, 200 cases, and middle ear disease, 182 cases. Enteric fevers accounted for only 253 cases, of which 207 were in India. A single case of undulant fever is reported, an *abortus* infection at York. There were 534 cases of pneumonia, with a case mortality of 10·6 per cent. It is of interest that the pneumonia figures of forty years ago, selected at random, give a mortality figure of 12 per cent. Considering the less efficient nursing then available, this suggests that effective treatment of pneumonia has not materially advanced. Some details are given of researches carried out by officers of the Royal Army Medical Corps.

International Oceanography

PROF. R. DE BUEN, with the co-operation of leading international oceanographers, has compiled a valuable chronological list of voyages, long and short, made by vessels of all countries that have resulted in addition to oceanographical knowledge ("Lista cronológica de las campañas y navegaciones a las que se deben observaciones científicas de caracter oceanográfico". Memorias del Consejo Oceanográfico Ibero-Americano, No. 5, Madrid, 1930). The entries are arranged separately for each country, and indications are in most cases given of objects or results of the voyages, names of the leaders, and in some cases of scientific personnel. The compiler is open to receive corrections or additions to the list, which indeed appears to be very complete already. The earlier entries, which begin at the end of the fifteenth century, are for voyages primarily of a geographical nature. It is interesting to note that the British records, although not given in great detail, occupy nearly one-half the whole.

Agricultural History

THE Agricultural History Society of America wishes to secure as full bibliographical information as possible relating to books or essays on agricultural history for inclusion in its quarterly journal. Writers in the British Isles of essays on farming history and the history of rural life in all its phases, are therefore requested to forward details of their publications from time to time to the Associate Editor for Great Britain, Mr. G. E. Fussell, at 47 Maple Street, London, W.1. Information regarding sections of scientific works which contain historical data, works of general history, or the history of specific trades or districts which contain sections dealing with agricultural history, might also be included. The quarterly journal of the Society, *Agricultural History*, is obtainable on payment of an annual subscription of three dollars, which should be forwarded to the Treasurer, Agricultural History Society, Room 304, 1358 B Street S.W., Washington, D.C., U.S.A.

The Remsen Memorial Collection

FORMER students in chemistry at Johns Hopkins University have organised the chemistry alumni of the University, with Dr. Harry N. Holmes, of Oberlin College, as president, and Dr. Lyman C. Newell, of Boston University, as secretary. Two meetings are held each year, ordinarily at the time of the meetings

of the American Chemical Society. At the last meeting it was decided to establish a Remsen Memorial Collection, and an appeal has been issued for early portraits of Dr. Remsen, autographed letters on scientific subjects, and inscribed copies of the first, or an early, edition of his books, particularly books in a foreign language. Those who have memorabilia of this kind are requested to write to Dr. Lyman C. Newell, 688 Boylston Street, Boston, Mass.

Science in Poland

THE recent issue of vol. 14 of "Nauka Polska" (Science and Letters in Poland), published by the Institute for the Promotion of Science and Letters in Poland (J. Mianowski Funds, Warsaw, Staszic Palace. 1931), is in line with the former volumes of this publication. It contains several original articles on the organisation and progress of science in Poland, as well as in Germany, Hungary, Czechoslovakia, Yugoslavia, Spain, and the United States. One article gives a review of the professorial members of Polish State universities. News of scientific activities and congresses both in Europe and America and reviews of new books are also included.

Science Abstracts

ALTHOUGH the volumes of *Science Abstracts* for 1931 are slightly less than those for the previous year, they include a larger number of abstracts: in physics 4365, of average length 0·254 page, and in electrical engineering 2697, of average length 0·262 page, there having been a marked decrease in the latter figure from last year. Both author and subject indexes are ample, and the two volumes continue to be indispensable for reference.

Announcements

AT the annual general meeting of the Society of Public Analysts, held on March 4, the following were elected as officers for the year 1932: *President*, F. W. F. Arnaud; *Hon. Treasurer*, E. B. Hughes; *Hon. Secretary*, G. Roche Lynch.

AT the annual general meeting of the Ray Society, held on March 10, the following officers were elected: *President*, Sir Sidney F. Harmer; *Treasurer*, Sir David Prain; *Secretary*, Dr. W. T. Calman. Sir J. Arthur Thomson, Prof. F. E. Weiss, and Mr. E. T. Browne were elected new members of Council. In the report of the Council it was announced that the second volume of "British Freshwater Copepoda" is in the press and will be issued to the subscribers for 1932. It was also announced that Dr. R. W. T. Gunther has presented to the Society a portrait of his late uncle, Prof. W. C. M'Intosh. By permission of the President and Council of the Linnean Society, the portrait has been hung in the rooms of that Society.

IN connexion with the Thomas Gray Memorial Trust, the objects of which are the advancement of the science of navigation and the scientific and educational interests of the British mercantile marine, the Royal Society of Arts, which founded the trust as a memorial to Thomas Gray, formerly assistant secretary to the Board of Trade (Marine Department), is again offering two prizes, each of the value of £100. One prize will be awarded for a valuable improvement in navigation proposed or invented in 1931 or 1932, and the other for an essay in connexion with navigation. Further particulars can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.2.

A CATALOGUE (No. 386) of nearly 3000 works relating to practically all branches of science, and a section on publications of the learned societies, has just been issued by Messrs. W. Heffer and Sons, Ltd., Petty Cury, Cambridge. It should be of interest to many readers.

AN item of particular interest to be included in the sale by auction by Messrs. Sotheby and Co., 34 New Bond Street, W.1, on March 21 and the following day is Michael Faraday's electrical plate machine, made to his order by E. G. Wood of Cheapside, 1830, and exhibited at the Faraday Centenary Exhibition in September last. The sale will also comprise some letters of Charles Darwin and F. T. Buckland, and a collection illustrating savage art, from Africa, America, Oceania, and New Zealand.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A sub-librarian of the Literary and Philosophical Society, Newcastle-upon-Tyne—The Librarian, Literary and Philosophical Society, Newcastle-upon-Tyne (March 28). A woman lecturer in mathematics at the Bingley Training College—The Education Officer, County Hall, Wakefield (March 30). A principal of the Sunderland Municipal Technical College—The Chief Education Officer, 15 John Street, Sunderland (April 9). A pathologist, a radiologist, and a pharmacist at the Southend-on-Sea New General Hospital—The Secretary, New General Hospital, Southend-on-Sea (April 10). A woman lecturer in biology at the Edge Hill Training College, Liverpool—The Principal, Edge Hill Training College, Liverpool (April 29). A demonstrator in physiology and a part-time demonstrator in geology at the Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (April 30). An assistant in the department of technology, City and Guilds of London Institute, for technical examination work, preferably with industrial knowledge, who has taught engineering or chemical subjects—The Superintendent, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, S.W.7. A director under the International Tin Research and Development Fund, to organise and direct international research and development, with the object of expanding the existing markets for tin, and of finding new uses for the metal—Sir John Campbell, 2 Richmond Terrace, London, S.W.1. A professor of education and head of the men's training department of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Expanding Universe

SIR ARTHUR EDDINGTON'S recent work is of extraordinary interest, though there is some difficulty in getting hold of the right end of the stick. His recent Friday evening discourse at the Royal Institution appears elsewhere in this issue, however, and he also gave a rather fuller account of the work in his presidential address to the Physical Society last November.

It appears that in Einstein's theory of gravitation there are two terms in the expression for the gravitational action of one piece of matter on another. One term is the usual attraction, varying inversely with the square of the distance; while the other is a much smaller term, which can usually be neglected, representing an opposition force, or what can be spoken of as a repulsion, varying as the direct first power of the distance. This last only becomes important at enormous distances, but it is clear that at some distance or other it must first equilibrate the attraction, and then overpower it. It is obvious that the equilibrium thus obtainable between attraction and repulsion must be of the unstable kind; and it is supposed that if at one time the universe was in that critical condition of equilibrium as regards the matter on the outskirts of the whole system, the repulsion has now got the upper hand, so that any very distant matter is now receding, and receding with increasing speed as the distance increases. The result would seem to be that the matter outside the equilibrium boundary would gradually go away to infinity, while the matter inside that boundary would gradually contract.

I remember discussing with the late G. F. Fitzgerald how it came about that the forces between particles of matter were all of one sign, so that all matter attracted every other kind, and wondering whether there was any kind of matter that would be repelled, on the analogy of electric charges. Fitzgerald's view was that if there was any of the opposite kind of matter, it would have been repelled long ago, and could only be found at infinity. The Einstein theory, however, does not postulate another kind of matter, but another kind of force acting on all matter, so that it is all subject to both attraction and repulsion; though, in a reasonable neighbourhood, attraction is dominant.

Eddington, however, has further examined the repulsive term, or what he calls the cosmic constant, and finds that it, like the attractive one, can be related to a hypothetical curvature of space, so that what he speaks of as 'the expanding universe' does not signify merely an expansion of the universe of matter, but an expansion of the whole continuum in which the matter exists. This is a much more difficult idea than an effect on matter alone. It may be asked why the continuum should behave as a unit and all act together. The curvature of space is presumably due to the matter in it, the radius of curvature depending on the amount of matter. By certain equations, hitherto associated with atoms and electrons, Eddington considers that he has been able to calculate the radius of curvature of space, at least for the equilibrium condition, also the rate at which it should increase, and likewise the original amount of matter contained in space. He finds this amount equivalent to 10^{79} atoms of hydrogen. If the amount of matter is gradually decreasing, owing to its conversion into radiation, then it may be reasonable to suppose that the radius of curvature is increasing, unless indeed the radiation generated by the conversion can be considered gravitationally equivalent to the matter whence it was derived. For the radiation can never get out of the curved space, and so the content of that space may be considered constant, whichever form it happens to take.

There seem to be some discrepancies here, so that I feel sure I have not stated the position accurately; but in a subject of this novelty an old-fashioned physicist may be allowed to ask questions, and one way of asking a question is to make a statement and ask for a correction. One can but admire the heroic and apparently successful attempt of Sir Arthur Eddington to calculate a value not only for the things already mentioned, including a recessional velocity in remarkable agreement with spectroscopic shift, but also for the relative mass of a proton and an electron. I only hope that his theory will stand scrutiny.

OLIVER LODGE.

Normanton House,
Lake, Salisbury.

Leadership and the Royal Society

MANY will sympathise with Dr. Norman Campbell in his desire that the Royal Society should ever exercise that leadership which is its right; all will regret that he should have supported his views by such misleading statements as are contained in his letter in NATURE of March 5. He states that "the only evidence"—of scientific merit—"demanded is a complete list of the candidate's scientific publications". No such list is ever asked for by the Society; no evidence is demanded from the candidate himself.

The Society is bound by its statutes, which provide that "Every Candidate shall be proposed and recommended by a certificate in writing signed by six or more Fellows. . . . The certificate shall specify the name, rank, profession, qualifications, and usual place of residence of the Candidate." The statutes also assign to one of the signatories, acting as proposer, the duty of "informing the Candidate of the Obligation to be subscribed . . . to . . . before he can be admitted as a Fellow", and require that the certificate shall be suspended in the rooms of the Society.

In some cases, no doubt, the proposer thinks it desirable to add to the certificate a list of publications; there is no demand for this, and I agree with Dr. Campbell in thinking that little attention is paid to it. I have taken part in the selection of fellows on many occasions, and do not remember one on which the list was referred to.

Dr. Campbell continues with a list of qualifications about which he says no inquiry is made. Long experience enables me to deny this, and to state that information of the kind indicated is always available and is considered by the council at the time of selection. It is obtained not from the candidate himself—he is asked no questions—but from his supporters and those conversant with his work.

Another statement made by Dr. Campbell is the following: "Election to fellowship confers rights and privileges, it imposes no duties". Let me again quote the statutes: "Every person elected a Fellow of the Society shall, before his admission, subscribe the Obligation in the following words:

"We who have hereunto subscribed, do hereby promise each for himself, that we will endeavour to promote the good of the Royal Society of London, for Improving Natural Knowledge, and to pursue the ends for which the same was founded".

As to those ends, they are to be found in the charter of 1662; here are the words of our founder, Charles II.:

". . . we look with favour upon all forms of learning, but with particular grace we encourage philosophical studies, especially those which by actual experiments attempt to shape out a new philosophy or to perfect the old."

So the King founded the Royal Society, enjoining on the fellows and their successors that their "studies are to be applied to further promoting by the authority of experiments the sciences of natural things and of useful arts".

These are the ends for which the Society was founded, and its long record shows how brilliantly it has set itself, and still continues, to achieve them, working as a band of fellows.

It happens that on the morning of Friday, March 4, before I had seen Dr. Campbell's letter in NATURE, I wrote a brief note to one of those whose names appeared in that morning's *Times*, congratulating him that I could now claim his help, not as that of a kind friend, but as a brother fellow; and that, I believe, represents the feelings of the fellows towards their colleagues.

Of course, fellows do recognise it as their duty and privilege to serve their humbler colleagues. *Noblesse oblige* is their motto, and as a senior member of the Society, I claim that it is still animated by the spirit of its founders, and does care far more for the welfare of science than for the dignity of its fellows.

R. T. GLAZEBROOK.

Ballards Oak,
Limpsfield, Surrey.

Complex X-Ray Characteristic Spectra

IT is well known that for the excitation of the characteristic X-ray spectra of elements, an electron has first to be removed from some internal level; when this is done, an electron from an outer level jumps to this vacant place, and characteristic radiation is emitted. The spectrum is called K, L, M ..... according to the level of the atom from which the electron was first removed.

This explanation suffices for the origin of the diagram lines, which show the same structure as lines due to alkalis, but there are, besides, other lines, the origin of which is still a matter of debate. Some of these have been traced to forbidden transitions;[1] but in addition, there are the so-called spark lines, which appear as faint satellites to the diagram lines. Hypotheses[2] have been advanced which ascribe these to double ionisation and single transition.

In this note we wish to direct attention to the existence of a third class of characteristic lines, which are due to *double ionisation and double transition*. Suppose in one single act of bombardment of the anticathode by electrons, two electrons are removed simultaneously from an internal level, say one from L_1, the other from L_2, and these places are filled up by simultaneous passage of electrons from higher levels, say one from M_1, the other from M_3. It can be shown from quantum principles and from analogy with optical spectra that one of the transitions will be allowed, the other forbidden, so that in the above example the transition may be written as $(L_1L_2 \leftarrow M_1M_3)$; it is a composite transition and is the sum of the two transitions (1) $L_2 \leftarrow M_3$, which is allowed, and (2) $L_1 \leftarrow M_1$, which is forbidden. Lines due to such transitions are quite common in optical spectra: for example, in the case of Ba $6s^2\ {}^1S_0 - 5d\,.\,6p\,.\,{}^1P_1$ λ3501·1 cited by Russell and Saunders[3] in their classical paper on the spectra of alkaline earths.

There is no reason why double transitions should not occur in the X-ray region. But *their frequency will be approximately* double the frequency of the usual L-lines, and since the electron configuration in this case is $2s\,.\,2p^5 \leftarrow 3s\,.\,3d^9$, the lines will form a multiplet $({}^1P, {}^3P) \leftarrow ({}^1D, {}^3D)$, provided Russell-Saunders coupling continues to hold in such cases. *The fact that their frequency will be double the usual L-spectrum frequency marks them out as a distinct class.*

Attempts have been made in this laboratory to obtain such lines from a tungsten anticathode, and two lines have been obtained with the wave-lengths $\lambda = 723$ and 682 X.U. They are diffuse lines impressed on a continuous background, and may be found to be attended with satellites when higher resolution is used. These wave-lengths are approximately half the wave-length of tungsten L-lines. After searching the literature to determine whether such lines have been noticed by any previous worker, we find that Rogers[4] noted in 1923 the following lines from tungsten: $\lambda = 1450$, 1373, 1321, 1248·7, 1230, 1114, 1086 X.U. These have not been traced to the tungsten levels, or identified as satellites or non-diagram lines, and cannot be ascribed to any other element. But it will be seen that the wave-lengths of the first two of Rogers' lines are very nearly double the wave-length of the lines obtained by us. Hence it may be safely concluded that the lines obtained by Rogers are the same double transition lines obtained in the second order.

The full multiplet will be dispersed over a large wave-length range, and, with our present apparatus, such long exposures (amounting to a hundred hours) are needed that considerable time must elapse before the whole set of lines can be photographed. But the fact that double L-frequency lines have been obtained at all indicates that the ideas presented here are essentially sound.

We think that we have established the possibility of getting double transition lines constituting complex spectra in the X-ray region. To get double transition or multiple transition lines due to all elements will be a vast programme, but when this is done, it will probably afford us very useful material for working out coupling problems inside the atom. The idea probably explains the numerous critical levels obtained by Richardson and his students: for the most part, these levels have no apparent connexion[5] with the recognised X-ray levels which give rise to the diagram lines. This fact is at present inexplicable; but supposing the quantum theory can be adopted to explain the fact, then combining this with the ideas presented here, we find that we get an unforced explanation of the numerous levels obtained by Richardson, and need not give up the Bohr-Stoner levels (cf. Richardson[6]). The J-phenomenon also does not appear to be so inconceivable, as according to our views we may have characteristic lines approximately double the frequency of ordinary K-lines.*

M. N. SAHA.
SALIGRAM BHARGAVA.
J. B. MUKERJI.

Department of Physics,
University of Allahabad, Feb. 5.

[1] S. Idei, *Sci. Reports Tôhoku Imp. Univ.*, **19**, 560.
[2] B. B. Ray, *Phil. Mag.*, **8**, 772; 1929. Langer, *Phys. Rev.*, **37**, 457; 1931.
[3] Russell and Saunders, *Astro. J.*, **61**, 38.
[4] Lindh, "Handbuch d. Experimentalphysik", xxiv/2, p. 172.
[5] Chalklin, *Sci. Prog.*, Jan. 1932, p. 437.
[6] Richardson, *Proc. Roy. Soc.*, A, **128**, 63; 1930.

* The following cablegram dated Feb. 29 has been received from Prof. Saha:

Double transition K-line approximately double frequency K-alpha three obtained copper.—SAHA.

Rotation of Chain Molecules in Solid Paraffins

IT is found that the thermal expansion of the crystal lattice of *n*-paraffins is not equal in all directions.[1] The increase in length of the *a* axis measured in the range of liquid air temperature to room temperature is about 7 per cent, of the *b* axis about 2 per cent, whereas the *c* axis remains practically unaltered. This axis is parallel to the chain axes of the molecules.

Recent X-ray measurements on a series of solid paraffins between room temperature and the melting points show that the *a* axes continue to increase at a higher rate than the *b* axes. The result is a change in the lattice dimensions which will be discussed presently. Fig. 1 (i) illustrates the packing of the molecules characteristic of all the members of the series. This arrangement is observed when the substances are at room temperature. Fig. 1 (ii) is the corresponding pattern near the melting points.

The rectangles represent the boundaries of the cross-section through the unit cell containing the *a* and *b* axes. The long axis of the chain molecule is perpendicular to the plane of the paper. The projections of the chains, which consist of a zigzag arrangement

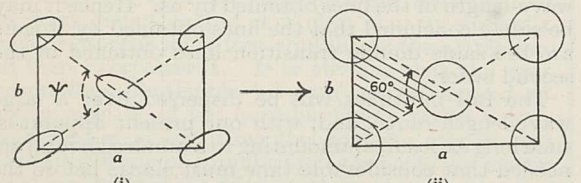

FIG. 1.

of CH_2-groups, are shown as ellipses in Fig. 1 (i). There are two types of orientations present of these ellipses when the crystals are at room temperature. The angle ψ is between 67°10′ and 67°40′ at 18°-20° C.

The angle ψ depends upon the temperature. It decreases with rising temperature, the expansion of *a* being larger than that of *b*, until it reaches 60° near the melting point. This is found to happen with C_{21}, C_{23}, C_{24}, C_{25}, C_{26}, C_{27}, C_{29}, C_{30}, C_{31}, C_{34}, H_{44} and can, therefore, be regarded as the general behaviour of the whole series within that range. If $\psi = 60°$, the triangle shown by cross-hatchings is equilateral and the arrangement in (ii) has apparently higher symmetry than the original arrangement (i).

The transition from (i) to (ii) is continuous, that is, there is a gradual change of the two axes *a* and *b* as the temperature increases with $C_{21}H_{44}$ and $C_{23}H_{48}$. From $C_{24}H_{50}$ onwards all the samples investigated show a sudden transition at about 5° to 10° C. below the melting point of the individual substance. The arrangement after this transition has taken place is still of the same type as (i) and approaches (ii) gradually as the temperature gets near the melting point. These transitions are incidentally those for which Garner and his collaborators have measured the heat of transition.[2]

The change from a less symmetrical arrangement at low temperature to another of higher symmetry at high temperature is not difficult to visualise. The moment of inertia of the chain molecule relative to its axis is comparatively small, and oscillations of large amplitude or complete rotations are to be expected at higher temperatures. Such oscillations obviously tend to produce fields of force round the chain axes which, when averaged, show radial symmetry and produce the simple close packed structure found in the present experiments.

The observations show that too high a symmetry may be observed in a crystal if the temperature at which the measurements are made is above a certain limit. A similar case for a crystal of amylammonium chloride has recently been discussed by Pauling.[3]

ALEX. MÜLLER.

Davy Faraday Laboratory,
Royal Institution,
London, W.1,
Feb. 24.

[1] *Proc. Roy. Soc.*, A, **127**, 417; 1931.
[2] *J. Chem. Soc.*, p. 1533; 1931.
[3] *Annual Survey of American Chem.*, **15**, 118-125.

Ovis astore, a Three-Coated Sheep

IN Prof. Barker's description of the sheep from Astore (Gilgit),[1] several points which bear upon his subsequent discussion of the development of the fleece of domesticated sheep are not clear. For example, it would be of great interest to know (1) whether the individual animal described is typical of many in that locality, that is, of a local variety or 'breed' or is a crossbred, and (2) the conditions of husbandry under which the animal had been maintained while the coat was grown, since changes of husbandry, including nutrition, can give rise to marked changes in thickness of the fibres throughout their lengths.

The difficulties encountered in endeavours to relate the coat constitutions of domesticated sheep with a two-coated primitive type are mentioned by Prof. Barker, but when questions other than those of fibre structure are introduced, the situation becomes more complicated, since a classification of the constituent fibres into two groups is no longer possible. Crew,[2] while insisting upon the two main types of hair and wool, distinguished three groups of *hairs* when classed according to length and colour in the summer coat of *O. ammon poli*. The coat of domesticated sheep exhibits two types of fibre—kemp and wool—and Fraser Roberts has shown that the distinction between these can best be made according to period and duration of growth; the 'heterotypes' of Duerden are fibres which exhibit kemp-like structures for a part of the length. Again, in the normal coat of the Scotch Blackface breed, the so-called 'double-coat' is really a triple coat, since the obvious groups of fibres are (1) kemp, (2) coarse, long fibres, and (3) fine, under-coat fibres.

Fraser Roberts, in a series of papers on "Colour Inheritance in Sheep",[3] discusses the various regional differences in coat pigmentation and describes the types of pigmentation found in individual fibres in the coats of primitive forms; if fibre pigmentation is included, the possible classification of coat fibres is greatly extended. In the Suffolk breed occur kemps, coarse wool fibres, and fine wool fibres, each of which may be, at least, wholly pigmented, non-pigmented, banded, or parti-coloured; and even in the adult fleeces of this breed there appear to be different thresholds of pigment inclusions for the various types of fibre, it having been noted, for example, that the kemps are more likely to be pigmented than are the neighbouring wool fibres growing during the same period.[4] Further, in the Merino breed, with no coat colour pattern, individuals which show 'banded' fleeces are not uncommon, and Boyd[5] recognised four main fibre types which contributed to the gross appearance of these fleeces, with, in one of four Merino fleeces analysed, an additional fifth type.

As Prof. Barker suggests, the degree or time of shedding of the fibres in the sheep described may throw some light upon its general coat constitution, but it may be questioned whether there is sufficient evidence

forthcoming from differences in fibre pigmentation to warrant their adoption as criteria in the differentiation of species of *Ovis*.

J. E. NICHOLS.

Wool Industries Research Association,
Torridon, Headingley,
Leeds, Feb. 3.

[1] NATURE, Jan. 23, p. 128.
[2] *Annals of Applied Biology*, 1921.
[3] *Jour. of Genetics*, 1924, 1926, 1928, 1930, 1931.
[4] *Jour. of the Textile Institute*, 1927.
[5] *Ibid.*, 1930.

DR. NICHOL'S letter confirms the value of the observations on the sheep which I have, simply for convenience, designated *Ovis astore* in my letter in NATURE of Jan. 23. I am still in the midst of my investigations into Kashmir wools for the State Government, but there is already evidence that in a certain district all, or nearly all, the sheep carry double-coats of wool.

About 1912 I was associated with the late Prof. T. B. Wood, of the University of Cambridge, in his experiments in crossing Merino sheep with Shropshire. Messrs. Bailey and Engledow came to work with me at Bradford and got out possibly the first diameter frequency distribution curves published with reference to wool. These showed two modes giving the suggestion that two types of fibres—Merino and Shropshire—were being grown in the same (crossbred) fleece. Three years ago I also experimented with the Wembley Merino crossed Lincoln wool. On combing this, the 'top' was very like Lincoln wool and the 'noil' very like Merino wool! Iceland wool is noticeable as yielding a coarser outer-coat fibre and a more valuable under-coat fibre. None of these examples corresponds with *Ovis astore*.

I am surprised that Dr. Nichols does not cite such a sheep as the Rough Fell sheep, which, about July, shows an outer-coat growth, and at the roots of the outer-coat fibres an under and shorter wool growth. This under-growth, however, is of fine wool, whereas the *Ovis astore* under-growth is of coarse wool and is sometimes pigmented and sometimes white. Possibly Dr. Nichols has had this phenomenon under his eyes and missed it, as I did until coming across *Ovis astore*. The Black-headed Persian is much in evidence in Kashmir and is also being used for crossing in South Africa. Among the woolled skins I have from South Africa is that of a Black-headed Persian × Suffolk Down (twice crossed). This shows a pigmented under-growth of strong fibre. Whether there has ever been the outer-growth of strong hair-like fibres or kemp I cannot say, but it is very probable.

Prof. Cossar Ewart and myself were among the first to recognise the kemp birth coat of Merino lambs as possibly the outer-coat of the wild sheep, and it may be that *Ovis astore* will bring into prominence the time of shedding of this outer-coat—early or late. The stronger outer-coat of *Ovis astore* certainly seems to correspond with the black outer-coat of the Black Wolf—the phenomenon of growth is apparently the same in both cases.

Dr. Nichols is scarcely kind either to himself or to me in suggesting that I have mistaken a thickening of the normal wool fibre for a stronger under-growth, and a colour-banding of the normal fibre for a coloured under-growth. This latter phenomenon I became acquainted with some thirty years ago, and I have also read and adjudicated upon Miss Boyd's thesis on this subject.

ALDRED F. BARKER.

The University,
Leeds.

Inheritance of Milking Capacity

MR. MADSEN'S letter in NATURE of Jan. 30 contains much interesting information, based, as it is, upon data unusually numerous and comprehensive. It is with regard to his conclusion concerning the evidence of transmission of some factors for milk-inheritance in a sex-linked manner, based upon the difference in the correlations of the sires to their paternal grand-dams (0·026) and their maternal grand-dams (0·112), that I should like to make two points.

(1) The small correlation to the paternal grand-dam (0·026) might be explained by the choice of the sires by genotypic rather than by phenotypic methods; the merits of the progeny test having been for some time widely recognised in Denmark. The insufficiency of a single cow's record (because it is the expression of a phenotype) in foretelling the production of her progeny, has been stressed by many investigators, and it is doubtful if one should expect to find a significant difference in the correlations of two such records diluted through three generations.

(2) The difference between the correlation co-efficients, 0·026 and 0·112, is not significant. From the data tabulated it appears that such a difference would be likely to occur by chance once in ten times. The odds are, therefore, not great enough to warrant the postulation of sex-linkage for some factors, from the data used.

J. EDWARDS.

School of Agriculture,
University of Cambridge, Feb. 5.

Contact of Smooth Surfaces

As the result of experiments described in the December number of the *Proceedings of the Royal Society*, Messrs. Bastow and Bowden conclude that "When a finely polished plate is lowered on to another polished surface . . . the top plate will sink until the two surfaces are in close contact. The apparent 'floating' at a height of 4 μ is due to dust or particles between the plates". The implication is that the floating is due to particles with a diameter approximating to 4 μ. With the conclusion I agree, since, in spite of many attempts, I have never succeeded in reproducing Sir William Hardy and Miss Nottage's results with carefully cleaned surfaces; with the implication I disagree entirely. In the case of metal plates, the somewhat elaborate apparatus used by Messrs. Bastow and Bowden is quite unnecessary. All that is required is to clean the plates with reasonable care, exposed to the air of the room, and lay one on the other as gently as possible. It will then be found that they are in electrical contact.

In my experience [1] it is only with slightly contaminated surfaces that the floating effect is observed, but the point is that the thickness of contaminant is far less than the distance between the plates. When artificial 'dust' in the form of glass fibres is introduced into the gap, the width of the latter increases and is greater than the thickness of the fibres. A film of grease 1 μ in thickness is easily visible on a polished plate, while fibres 4 μ in diameter can be seen without particularly good eyesight. Messrs. Bastow and Bowden have made no measurements of the size of the 'dust' which they were 'sometimes' able to see. Surely they do not accuse former workers on this subject of such carelessness that they failed to observe particles 4 μ in diameter; yet if they admit that floating is due to particles of smaller size, the problem remains *in statu quo*.

H. E. WATSON.

Indian Institute of Science,
Bangalore, Dec. 31.

[1] *Proc. Roy. Soc.*, A, **123**, 195; 1929.

THE experiments described in our paper have shown that small polished plates, *whether clean or contaminated by vapours or liquids*, approach within about 0·3 microns when brought gently together in a dust-free atmosphere. Clean plates showed the same separation *in vacuo*, and this distance corresponded with the known limit of flatness of the plates. Later experiments with polished glass plates up to 10 cm. in diameter have confirmed this conclusion, since, when placed together gently in the air of the laboratory, they frequently showed first order interference colours and a mean separation of about 0·3 microns. The exact separation under these conditions depended on the amount of dust present in the atmosphere, but it was seldom as great as 4 microns. There was no evidence for 'floating' either with clean or contaminated surfaces.

In Prof. Watson's experiment, two glass fibres 2·8 microns in diameter were laid on a polished steel plate and a polished steel cylinder placed on top. Instead of sinking down to within a distance of 2·8 microns, the cylinder appeared to float in the air at a height of 15 microns above the plate. After 'prolonged tapping', the air gap decreased to 6·36 microns, but the cylinder would sink no lower.

We have repeated this experiment, using glass surfaces and fibres 1 to 2 microns in diameter. When the fibres were short, there was no 'floating'; the separation was equal to the diameter of the fibres. When they were longer than a few millimetres, the separation was frequently as great as 15 microns, but an examination of the fibres showed that they were obviously crinkled. The amount of separation decreased with tapping, and depended simply upon the size of the crinkles.

It is, of course, impossible for us to say whether the same factor was or was not responsible for the large separation recorded by Prof. Watson, but, until there is some convincing evidence for 'floating', we consider that any separation between polished surfaces which exceeds the limits of flatness of the plates by more than a few molecular diameters must be attributed to something much more concrete than a mere cushion of air.

S. H. BASTOW.
F. P. BOWDEN.

Laboratory of Physical Chemistry,
Cambridge.

Apparent Formation of Copper Carbonyl

AN interesting observation has been made in the laboratory of the Department of Chemistry here on the apparent formation of copper carbonyl in the synthesis of methanol using certain catalysts containing copper.

It was noted that the passage of either hydrogen and carbon dioxide, or water gas, over a catalyst containing equal parts of copper, aluminum, and zinc, produced a liquid condensate which was quite colourless when blown from the high-pressure condenser. However, in a short time, apparently dependent upon the amount of water in the liquid, an evolution of gas occurred which was accompanied by the formation of a yellowish precipitate. Qualitative tests showed that copper was the only metal in this material. The precipitate appeared to be semi-colloidal in nature and was readily soluble in hydrochloric acid, which suggests that the copper was present as a hydrated oxide. This was further demonstrated by the results obtained using hydrogen and carbon dioxide, in which case the liquid contained equal amounts of water and alcohol, and precipitation occurred almost instantaneously upon removal of the pressure. Numerous other catalysts investigated did not show the phenomenon.

The possibility of this precipitate being formed by the hydrolysis of a copper salt formed in the reaction chamber is precluded by the lack of acidity in the condensate. If the evolution of gas were due to the release of pressure, this would occur at once and not after an induction period, as was the case with the water gas condensates. It was further observed that evolution was greatly stimulated by the addition of water, acid, or alkali to the condensates; and even after boiling an alcohol condensate, evolution could be obtained by the addition of water. Such phenomena seem to indicate the presence of a compound with similar properties to those expected of a copper carbonyl.

The analysis of the gases evolved by the liquids was not particularly enlightening, due to the complications added by the solubility of the gases in the liquid. Usually about 1 c.c. of gas was given off by 3 c.c. of liquid, and the composition varied greatly. Carbon dioxide was usually high, averaging about sixty per cent, but fell as low as 10 per cent; carbon monoxide averaged about 17 per cent, but was as high as 80 per cent on one occasion. Hydrogen was invariably low, while hydrocarbons accounted for a fairly constant value of 18 per cent. Interpretation of these results is extremely difficult.

Bertrand [1] claimed the formation of a copper carbonyl at atmospheric pressure, but Mond and Heberlein [2] were unable to verify this result. In our experiments with the above catalyst at atmospheric pressure and various temperatures there was no evidence of the formation of a carbonyl. However, pressure should favour such a reaction, and the product, apparently unstable at atmospheric pressure, would decompose as observed.

The experimental results indicated that the greater the amount of copper precipitated from the condensate, the greater was the activity of the catalyst. If this compound were an intermediate in the formation of methanol, such a result would be expected.

The formation of such an intermediate and the observance of carbon monoxide in the exit gas in the experiments involving carbon dioxide and hydrogen offers a new view on the mechanism of methanol formation which will be discussed elsewhere.

E. H. BOOMER.
H. E. MORRIS.
G. H. ARGUE.

University of Alberta,
Edmonton, Alberta, Canada,
Jan. 26.

[1] Bertrand, *C.R.*, **177**, 977; 1923.
[2] Mond and Heberlein, *J. Chem. Soc.*, **125**, 1222; 1924.

Trail of Bright Fireball of Feb. 24

ON Feb. 24, at $20^h\ 41^m$ G.M.T., a brilliant fireball passed over West Lancashire from south to north and was observed by many persons who have communicated their observations to me. I did not myself see the object, as I was in the Observatory exposing a plate for experimental purposes on the nebula in Orion, but I noticed the sudden brilliant illumination of the sky and the interior of the Observatory, and made a note of the time. On developing the plate next morning I found that the trail of the meteor was recorded on it, as shown on the accompanying print (Fig. 1).

The path of the meteor is very well defined, making an angle of 35° west of north with the declination circle of the nebula at the time of passage of the meteor. The trace shows well-marked periods of incalescence, and the brilliancy was obviously increasing rapidly during the interval of passage of the object across the portion of its path recorded on the plate, which is of a length of about 8°. This appears

to indicate that the point at which the meteor first became luminous would be not much to the south-east of the nebula.

The accounts received are for the most part descriptive of the appearance of the object, which had a brilliant bluish-white head, followed by a tail of considerable length, tapering to a point, and emitting showers of bright sparks. One or two observers note the appearance of brilliant prismatic colours in the part immediately behind the head. Information as to the apparent altitude above the horizon is lacking, but the track on the plate indicates that the meteor would pass a little above the Pleiades. From observers at Blackpool and Fleetwood it appears that the meteor passed a little to the east of the zenith in the former place, and a little to the west at the latter. From this it is deduced that the path of the meteor was approximately N. 5° E., passing slightly east of

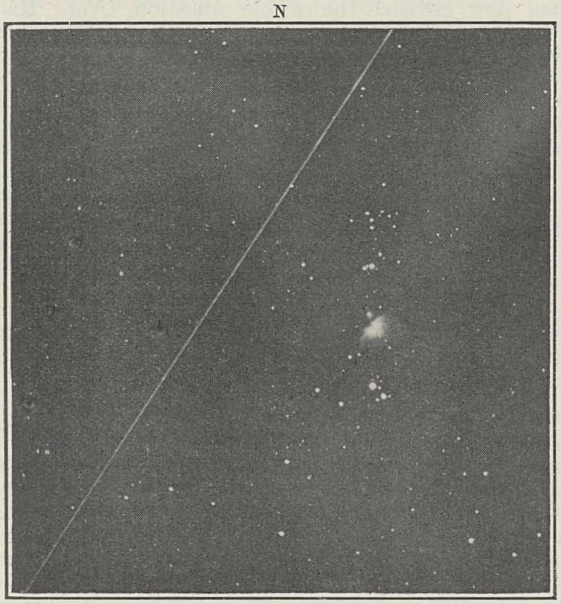

FIG. 1.

Blackpool, a line which produced southwards passes approximately over Chester, Hereford, and Bristol—but no information has been received indicating from how far south the meteor was visible.

Owing to the absence of reliable altitude observations, it is not possible to make an accurate determination of the height above the ground, but, taking more or less probable values, it may have been between 15 miles and 25 miles above Blackpool. If sufficient data come to hand to determine an accurate projection of the track on the earth's surface, measurement of the plate will enable an accurate determination of the height and inclination of the path to be made at points near the beginning of the track.

J. P. ROWLAND, *S.J.*

Stonyhurst College Observatory,
Nr. Blackburn, March 9.

The Voyage of the *Beagle*

IN the account of the voyage of the *Beagle* in NATURE of Dec. 26, 1931, there is a small point that requires correction. This relates to the first appearance of the title-page "Journal of Researches" in Darwin's publication.

His "Journal and Results" appeared as vol. 3 of FitzRoy's "Narrative" in 1839, as stated in the article, the publisher being Henry Colburn. The demand for Darwin's volume was immediately in excess of that of its companions, and Colburn therefore brought out in the same year a separate issue of vol. 3. Several preliminary leaves were omitted, and the title under discussion was introduced for the first time. The new title-page reads as follows: "Journal of Researches into the Geology and Natural History of the various countries visited by H.M.S. *Beagle*, under the command of Capt. FitzRoy, R.N., from 1832 to 1836". Some copies were also issued bearing the date 1840.

In Murray's second edition of 1845, the title-page of the second issue of 1839 was retained with slight alterations. 'Geology' and 'Natural History' were reversed in order, perhaps corresponding with a parallel reversal as to their relative degrees of importance in the author's opinion. The title-page in its altered form runs: "Journal of Researches into the Natural History and Geology of the countries visited during the voyage of H.M.S. *Beagle* round the World".

With regard to Colburn's dealings, the following letter from Darwin to his sister, written in Feb. 1842, gives some indication: ". . . Talking of money, I reaped the other day all the profit I shall ever get from my Journal, which consists in paying Mr. Colburn £21 10*s*. for the copies which I presented to different people:—1337 copies have been sold. This is a comfortable arrangement, is it not?"

Mr. Geoffrey Keynes has helped to elucidate the problems of the issues of the first edition, and I am indebted to him for having shown me a copy of a German translation that appeared in 1844, a year before real popularity was attained in England by Murray's second edition. I find that this publication is mentioned in "Life and Letters", vol. 1, p. 323, where the following quotation is given. Darwin says of the translation:—"I must, with unpardonable vanity, boast that it was at the instigation of Liebig and Humboldt".

N. BARLOW.

Boswells, Wendover.

Ancient Windmills

WITH reference to the letter under the above heading by Mr. H. P. Vowles in NATURE of Feb. 27, p. 317, there is in this library a copy of a Chinese work entitled "Ch'i Ch'i t'u Shuo" ("Record of Strange Machines from the West"), which is probably the source of the Chinese illustrations of machines referred to by Mr. Vowles. The book, which is on applied mechanics, was compiled in 1627 by Wang Cheng, a Christian convert, and contains fifty-four illustrations of machines, windmills, etc., which appear to have been copied directly from the sixteenth century sketch-books of Besson (1569), Ramelli (1588), and Veranzio (1595).

Our copy of the book was actually printed ("newly engraved") in 1829, but it contains prefaces dated 1627 by Wang Cheng, 1629 by one of Wang's pupils, and 1829. Whether these actually represent three separate editions of this particular work is doubtful, but the same illustrations appear in the great Chinese Encyclopædia of 1726 to which Mr. Vowles refers. The interesting point is that Wang Cheng says he compiled the book from information supplied by the Jesuit missionary, John Terrence (1576–1630), who went to China in 1620 and remained there until his death. He was a noted naturalist and mathematician.

The book was exhibited at a meeting of the Newcomen Society in 1925 (*Trans. Newcomen Soc.*, **6**, 85).

ALLAN GOMME.

The Patent Office Library,
London, W.C.2, March 5.

Research Items

Human Hair and Primate Patterning.—A study of the puzzling problems presented by the human hair has been made by Dr. Gerrit S. Miller and is published by the Smithsonian Institution (*Misc. Coll.*, vol. 85, No. 10). Most solutions offered assume tacitly that all the peculiarities of the human hair arise from man's special constitution and its reactions to the natural environment or to the artificial conditions that man has imposed upon himself; for example, that bareness of skin comes from the habit of wearing clothes; that baldness comes from barbers and wearing hats; that greyness is due to the lessening of bodily energy which goes with increasing civilisation and 'domestication', and so forth. These solutions do not take into account the zoological possibility that many features of the human hair may be generalised primate traits instead of specifically human developments. In other words, they may be special examples of 'patterning', a tendency which attains its greatest development in the primates. Human hair patterning shows itself more conspicuously in the head than on the limbs and body. It is not exactly duplicated in the head of any of the other primates, but all the elements can be found rarely in non-human members of the tribe. In man, both sexes have certain elements in common, but the females' pattern differs in the extension of the bare area over the whole of the base and the sides of the face. The first step in baring the forehead is shown in one of the Celebean macaques, while the essentially human forehead can be seen in the orang. Among non-human primates a bare or nearly bare area round the mouth is usual, while the extension of the bare area to the cheek is seen in the great apes. Yet some, such as the orang and the African guenon, have a beard like a male Caucasian or an Australian. Similarly, baldness, turning grey, and other features, as well as racial differences in man, can be shown to be instances of patterning.

Contact Modifications in Language.—M. A. Meillet, in a study of the modifications which result when a people changes over from one language to another (*Scientia*, vol. 5, Jan. 1932), points out that the student of the history of languages who confines his attention solely to the language which has survived runs the risk of over-simplification. A language may preserve intact the linguistic type of the tongue from which it derives its morphological characters, as the morphology of the French language contains no elements which are not derived from the Latin, and yet show the effect of influences to which it has been subjected. In the area that is now France two changes of tongue have taken place within historic times. Further, there are elements in French which can be explained as belonging to neither the Gallic nor the Latin tongues; they must be derived from a language spoken before the introduction of the former in the millennium before Christ. One of the effects of the introduction of Latin into Gaul was that a considerable proportion of the population must have become bilingual; and a second period of bilingualism followed after the invasion of the Franks. Of the latter there is evidence in, for example, the inverted form of interrogation after the German model "Kommt er?"; the use of *on* = *man*; the use of *rien* from Latin *rem* = *nicht*; the retention of *h*, features none of which was present in Latin. A second modification was the use of one language to express the mode of thought of another, as at the present day in certain localities German thought is expressed in a Slavic language. There is also the matter of accent, as the Provençal retains the Provençal or Gascon pronunciation of the vowels as opposed to the standard of Paris and the north. Further, tendencies in the earlier language may be inherited and influence the development of the derivative language. Thus certain progressive modifications observed in the Celtic tongue seem to have been carried over and to appear as tendencies influencing the development of French.

Four-Tusked Elephants.—During recent years there have been several newspaper discussions regarding the possible occurrence of large elephants with four tusks. Field observation tended to show that a few such specimens had been seen. J. G. Dollman has now revised the whole question (*Nat. Hist. Mag.*, Jan. 1932), and shows that various examples are known of abnormally grown tusks, which, springing from a single root, have split into several branches, sometimes quite distinct from one another. Sir Frank Colyer has suggested that sometimes such abnormal growth may have arisen from a divided tooth germ, and that many are doubtless due to injury of some sort—the passage of a bullet or the splitting of the tusk during the prising up of a tree root. It seems likely that such cases may parallel the cases of four-tusked elephants which have been recorded in the field, and that a true duplication of tusks (although mirrored duplication is a common enough form of abnormal growth amongst some animals) has so far not been proved for the tusks of an elephant.

The Elutriator in Biology.—The *Proceedings of the Linnean Society of London*, part I, 1931-32, contains a brief account of Mr. A. G. Lowndes's paper on the possibilities of the use of the elutriator in biology. This simple instrument depends on the use of different velocities of water current to effect a grading and separation of the finer particles of a powdered substance, but it is obvious that the method has considerable possibilities in comparing the swimming powers of various fresh water organisms. Mr. Lowndes describes the behaviour of various organisms he has studied. Two species of *Daphnia* with different powers of swimming could be completely separated in the elutriator, and the method would seem to have a wide range of usefulness, both in separating the organisms from mud or silt and in effecting some separation of the organisms from one another. It may also provide a useful method of studying the behaviour of various organisms which attach themselves to a substratum in various stream strengths.

Research on Tobacco.—In the fifty-fourth Report of the Connecticut Agricultural Experiment Station (*Bulletin* 326) an account is given of experiments dealing with various aspects of the tobacco industry. The practice of topping and suckering the plants is recognised by growers as producing better leaf growth, and the investigations showed that these processes, if properly carried out, would also accelerate the ripening of the leaves, reduce the liability of the plant to wilt and encourage root growth. Tobacco normally produces large numbers of seeds per plant, and the ease with which sufficient seed is obtained has led to a lack of attention being paid to its quality. Trimming the inflorescence, however, so as to allow only a limited number of pods to develop, was found to result in an increase in the weight of seed produced. Leaving some of the upper leaves on the stalk until the pods were mature had a similar effect, and since the

first formed pods in the centre of the inflorescence yielded the heaviest seeds, their selection is recommended. A study was also made of the effect of temperature and humidity on the rate of the process of curing and the quality of the final product. Relative humidities less than 70 per cent or more than 90 per cent were found unsuitable, the best results being obtained with 80-85 per cent humidity at a temperature of 95° F. for early and 85°-90° F. for late pickings.

Algæ in the South Indian Cretaceous.—Mr. L. Rama Rao, Central College, Bangalore, recently recorded the occurrence of *Lithothamnion* in some of the limestones of the South Indian Cretaceous (NATURE, **128**, 225, Aug. 8, 1931; **128**, 873, Nov. 21, 1931). He has since sent a further communication, in which he says he has now recognised algæ in the flints and cherts of the Niniyur (Danian) stage—especially in a band of flints from about a mile south-east of Sendurai. Some of the flints are 'pebbly', nearly 2 cm. in diameter, and, under the microscope, are seen to consist of patches of algæ. Others, which are more massive, reveal broad patches of algæ. *Lithothamnion* is common, while several other types of algæ occur. Before silicification, the rock appears to have been largely of the nature of an algal limestone.

Sedimentation in Coral Reef Regions.—The rate and nature of the sedimentation in coral reef regions is of importance with regard to their formation, and has been the subject of careful studies by Mayor, Vaughan, and others. The latest research is by S. M. Marshall and A. P. Orr, published by the British Museum (Natural History) in vol. 1, No. 5, of the *Great Barrier Reef Reports*. Bottles were placed down on the surface of the reef in different positions and in the anchorage to 3·6 m. Their contents were collected weekly, the contained sediments weighed and graded into size percentages. The loss by solution in 1 in 3 hydrochloric acid in the different grades was calculated, together with the further loss by ignition, and the ash residue. The percentage of the latter is small in the larger grades of sediment, but in the smallest shows varying amounts, 8-29 per cent. It is not clear whence this ash is derived. Almost the only organic material in the same are the frustules of diatoms, the bulk of the ash presumably being carried in suspension from the neighbouring high lands. Three hand borings were driven down to 15 ft. through the surface of the reef, and showed mud with little sand below 6 ft. This result was unexpected, the coral reef being a mere capping of a mud shoal. The ash in this mud varied up to 37 per cent, increasing in amount with depth. The last part of the paper contains experiments as to the effect of sediment on living corals. These show that the reef corals when helped by water movements are able to deal with any ordinary amount of mud or sand falling upon them. Coral colonies with large polyps and branching corals are best able to clean themselves, the immense *Fungia* polyps when buried from above almost seeming to "climb through 6 cm. of sand unaided". Ordinarily, sediment coming from below, due to movement of sand along the reef surface, "kills in a day or two all the polyps thus covered". We are hence driven to conclude that in protected situations within reefs there is little likelihood of coral colonies being killed by the deposition of sediment. Another explanation thus becomes necessary to explain the barrenness of such areas so far as coral growth is concerned.

Displacement Pumping of Oil-wells.—The evolution of production methods as applied to lifting oil from the reservoir after it has ceased to flow naturally has been marked by stages in which ordinary pumping, bailing, and swabbing have gradually given place to gas lift, at least in the penultimate phase of oil-well history. The effect of gas lift is to postpone the time when it is necessary to put the well 'on the beam', as it is termed, that is, the recovery of oil by direct pumping. Actually gas lift is practicable from the first sign of initial decline of oil-flow in the well until either running pressure and rock pressure are equal or until input oil to gas ratio becomes such that the practice has to be discontinued for economic reasons. In the circumstances the search has been for a method which would practically eliminate pumping altogether, for some mechanism which would make it possible to produce oil from the well by appeal to compressed air or gas when other forms of gas lift were impracticable. Displacement pumping, using air, has been known as a hydraulic process for raising varying quantities of fluid over moderate lifts for a long time; the 'displacement pump', of a type now adapted to oilfield work, is a comparative new-comer in this field, the operating medium being either gas or air. It is claimed that this method of bringing oil to the surface is practicable until the well has entirely exhausted itself, to the exclusion of the direct pumping stage altogether. A great deal of experimental work has been done in achieving this notable result in oil-well engineering, and the Institution of Petroleum Technologists was fortunate in learning about displacement pumping from such an able exponent of production technique as Mr. Albert Millar, whose paper was read on Feb. 9.

Artificial Disintegration of Aluminium.—The fields close to atomic nuclei can be investigated both by experiments on the scattering of α-particles and by experiments on artificial disintegration. In the case of aluminium, data obtained in both ways now exist, and are summarised and discussed by J. Chadwick and J. E. R. Constable (*Proc. Roy. Soc.*, Feb.). The scattering experiments, due to Riezler, fix the extension of the region within which α-particles are attracted by the nucleus and the height of the potential barrier at this point at about 5×10^{-13} cm. and 8 million electron-volts. Chadwick and Constable's extensive new experiments on the disintegration of aluminium by the α-particles from polonium show that within this barrier there are at least four energy levels into which α-particles can be captured. Their value is in the neighbourhood of five million electron-volts, and each is associated with the ejection of two groups of protons. The same picture also accounts for the production of γ-rays when aluminium is bombarded by the α-particles from polonium, and predicts that their energy should be about 2·3 million electron-volts, which is identical, within the limits of experimental error, with the results of the direct observations of Webster.

Moving Coil Reproducers and Flexible Disks.—Dr. N. W. McLachlan has recently discussed details of moving coil reproducers (*Phil. Mag.*, Jan. 1932). He determined the modulus of elasticity of paper and used it to compare the stiffness of conical sheets and disks of the same radius. The combination modes of a reed-driven paper disk are determined, and a comparison with theory shows that the paper must be heterogeneous. The exact solution for a reed-driven disk vibrating in a vacuum without loss is found. The case of a coil-driven circular aluminium disk was examined experimentally, and it was shown that the frequency band occupied by the first symmetrical mode is only five cycles. With constant current in the coil the output at resonance is about

two thousand times greater than at non-resonant frequencies. The author analyses the influence of the magnetic field upon the output and upon the coil impedance of the reproducer. It is shown that the oscillation of a coil driven by an alternating current in a non-uniform magnetic field is accompanied by a motion of translation, and he points out that this is akin to the process of the rectification of an alternating current. A series of impulse records is shown giving the natural damped oscillations of moving coil reproducers of the horn and large diaphragm kind. He deduces that their field of utility lies in the determination of the main symmetrical mode in the upper register and the low-frequency modes associated with the ' surround ' constraint.

Physical Properties of Nitrobenzene.—Mazur has reported (NATURE, **126**, p. 993 ; 1930) a sharp fall in the dielectric constant of nitrobenzene, an arrest in the heating curve (*ibid.*, **127**, p. 741 ; 1931), and a sharp change of slope in the density-temperature curve (*ibid.*, **127**, 893 ; 1931) at a temperature about 4° above the melting point, and the inference to be drawn from these results would be that there are two forms of liquid nitrobenzene. Massy, Warren, and Wolfenden (*J. Chem. Soc.*, Jan.) describe experiments on the viscosity and density of nitrobenzene at various temperatures which show no such discontinuities. The density curve is a perfectly straight line and shows no trace of the discontinuity reported by Mazur. Since the dielectric constant is intimately connected with the degree of orientation and capacity for free rotation of the dipoles of the medium, it is to be expected that the viscosity curve should show a break corresponding with the break in the dielectric constant curve reported by Mazur. Here again no trace of a break was found, the curve being a straight line.

Kolbe's Reaction.—The mechanism of the formation of hydrocarbons by the electrolysis of salts of organic acids, discovered by Kolbe in 1849, has been the object of a considerable amount of investigation. On electrolysing potassium acetate solution, for example, ethane and carbon dioxide are formed. Matsuda (*Bull. Chem. Soc. Japan*, Jan.) finds that an oxidising substance is formed during the electrolysis, which he identifies as hydrogen peroxide. He considers that acetyl peroxide is the primary product of the reaction at the anode, most of it being decomposed in the earlier stages of the electrolysis as follows: $(CH_3.COO)_2 = CH_3.CH_3 + 2CO_2$. It may also be hydrolysed into peracetic acid and acetic acid, or into hydrogen peroxide and acetic acid. The hydrogen peroxide will be decomposed in the alkaline solution, so that its amount will begin to decrease at a certain point in the electrolysis. The relation between the formation of hydrogen peroxide and the *p*H value and concentration of the solution were studied.

Astronomical Topics

Geological Studies of the Moon.—The surface of the moon is now known in such detail, thanks to excellent photographs and persevering telescopic study, that it is possible for the geologist to trace the steps of the formation of many of the features. Prof. O. Matousek, of the Charles' University, Prague, read a paper a year ago before the Geological Society of America, which is printed in the *Pan-American Geologist*, vol. 54. The Sinus Iridum is the region examined ; a diagram shows the various systems of faults, which divide themselves into groups in various directions, the parallelism of each group being very close. Two remarkable dislocations are indicated, in each of which a large region appears to have suffered a lateral shift of several miles. One is in the eastern cape, Heraclides; this is sometimes compared to a woman's head; the portion corresponding to the face has been shifted towards the north-west. The other dislocation occurs in the middle of the coast-line of the bay, producing a conspicuous little promontory. Several of the faults are marked by rows of small craters, and the author considers that in these cases at least the craters are genuine volcanoes.

Another diagram shows a vertical section of the bay, the strata being arranged in a manner deduced by the author from a study of the faults, which appear to have caused vertical displacements as well as horizontal ones. The floor of the bay is supposed to be the result of a great lava inundation.

Mr. W. Goodacre read a paper at the February meeting of the British Astronomical Association on a long cleft which he has detected in the south-east region of the Mare Humorum ; it does not appear to have been noticed before. It is probably a similar formation to some of those studied by Prof. Matousek.

Spectra of *B*-type Stars.—A useful contribution to the study of stellar spectra of type *B* has been published by Dr. O. Struve (*Astrophys. J.*, **74**, 225). Thirteen stars, covering all the sub-types from O_9 to B_8, have been investigated for the purpose of obtaining a reasonably complete list of wave-lengths and origins of absorption lines in these stars. A list is given of 379 lines between λ3820 and λ4924, of which 130 are newly identified with known elements. Only 73 still remain unidentified. Wave-lengths are given to 0·01 A., and origins (in the case of blends) appear in the order of probable importance of the components. Estimated intensities on an arbitrary scale of 1 up to 10 (excluding hydrogen lines, which may be so high as 50) are given for ten typical stars. An investigation is also included of the contours and intensities of the helium lines. Both neutral and ionised helium lines show an expected broadening by the Stark effect, but the relative intensities of He I lines vary in a curious manner. The intensity ratio singlet/triplet is at a maximum at type B_2, decreasing both towards type *O* and (more slowly) towards type B_9.

Annuaire Astronomique Camille Flammarion.—This attractive annual (Paris : Ernest Flammarion, 1932. 12 francs) is full of useful information: there are sunspot statistics from the beginning of the century; ephemerides and other information about the planets —it is well to point out that the ephemeris for Pluto, quoted from *Lick Bulletin*, is for the equinox of 1900 ; this is not stated in the *Annuaire* ; the correction for precession is $1\frac{3}{4}$ minutes of time, which would cause difficulty in identifying such a faint body. An omission in the diagram of future eclipses may also be pointed out ; this extends to 1950, but omits the important Norwegian eclipse of July 1945. There are diagrams of the important occultations of the year, which include several of the Pleiades and one of Regulus. There are also tide tables, and comet statistics, which are kept up to date by M. F. Baldet. The stellar information is very full ; there are reproductions of stellar spectra, and diagrams of the light-curves of variables. There are star maps for each month, with notes on the phenomena of each month. The book deserves a place on every astronomer's table.

Ice and the Formation of Alpine Scenery*

THREE dates stand out as landmarks when a special revival of interest in Alpine glaciology occurred: namely, 1840, when Jean Agassiz published his "Études sur les Glaciers"; 1862, when Ramsay read his paper on the glacial origin of lakes to the Geological Society and Tyndall published his paper in the *Philosophical Magazine*, in which he advocated a glacial origin for the Alpine valleys; and 1900, about which time Peach described the Alpine trough-valleys, and W. M. Davis emphasised the glacial overdeepening of the Ticino Valley, and when, a little later, Penck and Brueckner completed their monumental work on the ice age in the Alps.

It is not until the advent of the eighteenth century that we find any interest being taken in glaciers; then Scheuchzer, between 1706 and 1723, published various works on the natural history of Switzerland which contained some glacial observations, and in which he propounded the dilatation theory of glacier motion. He was followed by Gottlieb Gruner, who in 1760 published his "Eisgebirge", in which he describes the alternate advance and retreat of glaciers, illustrated by an account of the measurements of the Grindelwald Glacier between 1540 and 1750. De Saussure, between 1779 and 1796, published his famous "Voyages dans les Alpes", in which he defined the term 'glacier' and classified glaciers under three orders; in this work he also described *roches moutonnées*, which he attributed to water action, and he ascribed the transport of erratic blocks to a deluge or catastrophe. Though usually credited with the view that glaciers moved as solid bodies, his description of the Mount Dolent Glacier as moulding itself to the form of its valley shows that he recognised the plasticity of ice.

In the first half of the nineteenth century a new impetus was given to glacial studies by the observations of Schimper and Esmark and the writings of Venetz, Charpentier, and Agassiz, all of whom attributed the transport of the famous erratics now found on the Jura to the former greater extension of the present glaciers. This view had, however, been anticipated by Hutton.

* Substance of the presidential address by Prof. E. J. Garwood, F.R.S., before the annual general meeting of the Geological Society of London on Feb. 19.

The publication of Agassiz's "Études sur les Glaciers" did much to stimulate further observation on glacial phenomena during the next few years, but interest again waned after Agassiz's departure for America.

Ramsay's paper to the Geological Society in 1862 created renewed interest, fostered by Tyndall's views on the glacial erosion of Alpine valleys, and discussion was now directed to the work of ice as an erosive agent. Writers on this subject were divided into two camps. Whereas Wallace, Jukes, the brothers Geikie, Logan, Steenstrup, and Penck supported Ramsay, others, including Murchison, Lyell, the Duke of Argyll, Bonney, Rutimeyer, Heim, Credner, and Desor attributed but little erosive action to glaciers.

By the beginning of the present century most observers admitted some erosive action to ice, and more detailed observation focused attention on special features of Alpine scenery. Penck described the trough-shaped characters of Alpine valleys, and Prof. W. M. Davis attributed the hanging valleys and truncated spurs in the Val Ticino to the formation of the trough by glacial overdeepening. The origin of cirques was also discussed and was variously attributed to glacial erosion, water action, and frost action on the cirque wall. The work of Penck and Brueckner had established the occurrence of four glacial and three interglacial periods in the Alps, chiefly on the evidence of the deposits, and the benches which occur on the valley flanks confirm this conclusion. The truncation of the overlapping spurs which occur in the trough valleys shows, however, that the overdeepening must have been largely the result of river erosion during the last interglacial period, the valley having later been widened and modified by glacial action. Certain features, namely, the *arêtes*, cirque floors, the steep south side of the Alps, and in part the hanging valleys, appear to owe their special features to the relatively protective character of ice. The steps in the main and tributary valleys present special difficulties, and cannot be satisfactorily accounted for by simple glacial erosion. They appear to be due in some way to the alternation of glacial and interglacial periods, and may possibly also be due to protection by glaciers during interglacial periods.

Past and Present Whaling Records

IN the whaling ports which furnished the fleets of the nineteenth century lie many log-books containing records of long years of whale fishing. Charles H. Townsend has struck upon the happy idea of using the old records (in New Bedford Public Library alone there are hundreds of log-books) to obtain information regarding the great whaling grounds, the numbers of whales slain, the position and month of capture, and so on (*Bull. New York Zool. Soc.*, Nov.-Dec. 1931, p. 173).

There are several important collections of whaleship logs at Nantucket, Salem, and other New England ports celebrated in the history of the whaling industry, but these first records are drawn only from the New Bedford logs and refer only to the sperm whale. Nevertheless, the number of sperm whales represented by the plottings upon the chart accompanying the paper is no less than 11,026. The 'whaling grounds', including twelve in the North Atlantic, were visited during fairly definite seasons, as the plottings which record the position and month of each whale capture show.

In the North Atlantic the plotted areas above latitude 25° show the presence of whales, with few exceptions, during the April-September period, and in the Sargasso Sea the killings are almost wholly confined to the summer period of the northern hemisphere. Between lat. 25° N. and the equator, whales were taken chiefly during the October-March season, and along the coast of South America and towards the Cape of Good Hope the catches were largely made during the same season, or summer time in the southern hemisphere. Off Japan and along lat. 30° N. the period changes to the April-September season. In the Pacific and to some extent also in the Atlantic Ocean, catches for all months are recorded along the equatorial belts, and the cool Benguela and Humboldt Currents had the effect of creating all-the-year whale fisheries off the west coast of Africa and in the neighbourhood of the Galapagos Archipelago.

It must be remembered that whaling in itself was not a seasonal trade, but that the whalers made voyages lasting from two to four years, catching whales wherever they could; so that the seasonal distribution of the catches of sperm whales is the more significant. The author promises to publish further plottings of sperm whale records and of records of five other species of whales from logs still unexamined, and the results of his investigations will be looked for with much interest.

Records of present-day whaling are giving rise to serious conjecture with regard to the preservation of the number of whales. The number killed during the season 1929–30, according to the *Norwegian Whaling Gazette*, reached the record of 38,563 individuals. Of these, 19,080 were blue whales, 14,350 finners, 1923 humpback, 922 sei, 1352 sperm, and 936 other species. Of the total number, by far the greatest proportion was taken in antarctic waters, 30,654; Japanese waters followed with 1714, and the remainder were captured in tropical and northern seas. The whaler *Lansing* itself had a catch of 300 whales; shore stations in Alaska and British Columbia had 675. The slaughter of whales has become a much intensified process in recent years: the Norwegian antarctic whaler *Sir James Clark Ross* had seven steam whale-killing boats, a crew of 245 men, and had taken during the season 1445 whales, yielding 55,000 barrels of oil, which were sold to a soap-making firm at an estimated value of one and a half million dollars.

The total world-yield of whale-oil for the season exceeded 3,427,000 barrels, so that, through overproduction, much oil had to be stored, and as a consequence there is a slacking off in whaling during the present season. It is a relief to know that the whales will suffer less during a season, but even a years' total respite would help little towards the preservation of slow-breeding creatures like whales, in face of the capacity for slaughter of the new whaling craft.

Chinese Materia Medica

IN an article in NATURE of June 7, 1930, a description was given of the progress that is being made in the elucidation of the botanical origin of Chinese vegetable drugs, and it was pointed out that what might at first sight appear to be a peculiarly abstruse investigation, in which medical historians and anthropologists alone could be concerned, has resulted in a revival of interest in *Ephedra* and the use of its principal alkaloid, ephedrine, in the treatment of asthma.

Prof. Bernard E. Read, to whose labours this practical outcome was mainly due, is continuing these studies, and has published in recent issues of the *Peking Natural History Bulletin* a series of papers on Chinese drugs of animal origin, which have now been issued as a reprint. In preparing these papers, the author has had at his disposal specimens and notes of work done on Chinese materia medica at the Severance Union Medical College, Seoul, and the results of an attempt made by Miss Blanche Wu of the Department of Biology, Yenching University, to arrange the whole fauna used in Chinese medicine according to a modern scientific classification. There is, however, so much unidentified material that such a classification is still impossible.

The subject-matter is arranged in five sections: Domestic Animals; Wild Animals; Rodents; Monkeys and Supernatural Beings; and Man as a Medicine. In each of these sections the particular animals furnishing the drugs are dealt with, and much time and trouble has clearly been expended in relating the Chinese symbols and names to their precise English equivalents. The Chinese doctor was, and probably still is, quite catholic in his taste for drugs, and the article on the pig is reminiscent of the Chicago pork factory, where everything was used but the squeak. This catholicity is not confined to the parts of an animal used, but applies equally to the species regarded as coming within the scope of practical medicine, for man himself figures prominently as a source of drugs. In this respect Chinese medicine is no worse, as Prof. Read points out, than European medicine was in the sixteenth century, and, as he pleasantly puts it, the feverish activity with which every type of animal tissue is being examined for hormones, vitamins, and other specific agents for the treatment of disease "compels an open mind that one may reach beyond the unæsthetic setting of the subject to things worth while." T. A. H.

Forms of Communal and Industrial Waste

A PAPER read by J. L. Hodgson before the Royal Society of Arts on Jan. 20, discussing "Some Aspects of the Problem of Industrial and Communal Waste", included a number of highly controversial questions, but dealt with many matters which are the subject of much anxious thought to-day and, above all, merit the attention of scientific workers. The contrast between the immense potential productivity of the world, which is largely the result of the application of scientific method and discoveries, and the immense amount of poverty and unemployment which exists side by side with such productive powers, is essentially a challenge to scientific workers whose labours have been a vital factor in increasing the productive capacity of the world. Among other causes of the present position indicated by Mr. Hodgson are not only the numerous forms of industrial waste, but also those forms of communal waste such as armaments, tariffs, unemployment, inadequate housing, sanitary, medical, and educational facilities, restrictions on transport, and, sometimes, forms of rationalisation which tend to reduce the wealth and services available within a community.

These forms of communal waste are the outcome partly of ignorance and partly of vested interests, and they only persist through the absence of impartial scientific inquiry and analysis on a scale competent and authoritative enough to compel rational action.

Among the factors responsible for the present situation, the concentration of credit power in the hands of socially irresponsible people is regarded as fundamental, and in its reaction on industry has encouraged continued increase of technical efficiency, the reduction of wages and staff, replacement of skilled by unskilled labour, mass-unemployment, the formation of mergers or trusts, the growth of tariffs, leading ultimately to restricted output and sabotage of excess products.

Mr. Hodgson, pointing out the absurdity of production which leads only to waste, suggested that strenuous efficiencies are surplus, and that if communal wastes are eliminated and routine work efficiently organised and shared by all, a comparatively small amount of routine will be required of each individual worker. Our aim should be to organise the production of the goods necessary for the maintenance and

development of the community, or their purchase from outside in exchange for commodities produced at home, by the minimum expenditure of effort. In place of the existing credit system, the creation by the Treasury of notes to the value of goods and services available is suggested. These notes would be issued to individuals as wages or endowment, according to age, grade, or services rendered. No one would receive notes which are insufficient in value for the maintenance of a normal, ample life, and while suitable compulsion would be provided regarding a necessary two months' maintenance work, it would be unnecessary to fix an upper limit of remuneration since additional notes would be issued only for actual services and could not be loaned at interest. Under this system no taxation would be required, as the notes necessary to cover all national services would be withheld from distribution. Endowed leisure would be a prominent feature, and the system would definitely lead towards regional specialisation, the exchange between which would be by means of goods.

Chromosome Studies and Plant Breeding

THE breeding of plants with the object of obtaining new and improved varieties is at best a slow and laborious process, with chances of success by no means assured. Any means of prediction of the probable results of a cross would be of immense value, and Dr. Darlington shows in a series of eight papers [1] how far this object may be attained by a previous knowledge of the cytology of the forms to be crossed.

The author passes to the practical view of the question with the minimum of technical detail, and shows how very closely the behaviour of plants in breeding can be correlated with their visible chromosome behaviour. He gives us the picture of a fertile germ cell as carrying a set of chromosomes, which must represent a complete and balanced set of characters, for in exceptional cases such germ cells are able to develop into a new plant without fertilisation. Normally two sets of chromosomes come together at fertilisation and remain associated throughout vegetative growth until germ cells are formed again. In this latter process, an exact pairing of like chromosomes, which afterwards separate, one of each pair passing to each daughter nucleus, is usually associated with the production of fertile germ cells. Irregularity in this pairing frequently results in the production of unbalanced sets of characters in the germ cells, with loss or great reduction in fertility. This is a fundamental point in cross breeding, where the value of the hybrid depends on seed fertility, as in the case of cereals, cherries, and plums.

On the other hand, crosses between plants with different chromosome numbers, which result in sterile hybrids, may have advantages when the plant is required for ornamental purposes and can be propagated vegetatively.

Another interesting fact which has emerged from comparatively recent cytological work is that related species of plants often have either the same chromosome number or some multiple of a basic number: that is, they are naturally occurring 'polyploids'. Work on plants in cultivation and under cytological observation has brought forward facts which are most suggestive as to a possible way in which species may have been derived from one another. This is illustrated by the cross between *Primula floribunda* and *P. verticillata*, which results in a sterile hybrid. Occasional fertile seeds are, however, produced, and they give rise to plants with hybrid characters, but differing in being fertile and breeding true. Such seedlings—known as *P. Kewensis*—are found to contain twice the anticipated number of chromosomes, and as each parental set has been doubled in such plants, exact pairing is again possible with the passage of two complete balanced sets to each daughter nucleus. The relative numbers of chromosomes in naturally occurring species suggests that hybridisation followed by restoration of fertility by polyploidy is one possible method of their origin.

These and many other problems are dealt with fully in these papers. Although, as Dr. Darlington points out, the knowledge gained by a preliminary chromosome investigation cannot control the results obtained by a cross, it may be of great value in directing the activities of the plant breeder into lines which have some hope of success.

[1] *Gard. Chron.*, vol. 90, Nos. 2332-2347; 1931.

University and Educational Intelligence

CAMBRIDGE.—An appointment to a University lectureship in mathematics will be made in the Easter term, to take effect from Oct. 1. The initial basic stipend is £200 a year; but an additional allowance of £150 a year may be granted to a lecturer who is not a fellow of a College, and also a number of years' seniority carrying with it an increased basic stipend. Candidates are requested to send their names, with any evidence of qualifications which they may desire to submit, to Mr. W. J. Harrison, Secretary of the Faculty Board of Mathematics, Clare College, Cambridge, on or before April 30.

The examiners consider that the following submitted essays of distinction for the Smith's prizes and Rayleigh prizes: D. W. Babbage (Magdalene College), "Cremona Transformations"; J. Bronowski (Jesus College), "On a Representation of Primals"; J. Cossar (Magdalene College), "On Fourier Integrals"; V. V. Narliker (Non-Collegiate), "Cosmogony and Astronomical Dynamics"; H. M. Taylor (Clare College), "The Anomalous Scattering of X-Rays". The Smith's prizes are awarded to D. W. Babbage and H. M. Taylor, and Rayleigh prizes to J. Cossar and V. V. Narliker.

Dr. J. A. Venn, Gilbey lecturer in agriculture in the University, has been elected president of Queens' College.

LONDON.—The degree of D.Sc. in chemistry has been conferred on Frank Bell (Battersea Polytechnic) for a thesis entitled "Polarisation and Chemical Reactivity in Aromatic Substances" (*J. Chem. Soc.*, 1928–30).

APPLICATIONS are invited for the Henry George Plimmer fellowship in pathology of the Imperial College of Science and Technology, for research in morbid anatomy, histological anatomy, chemical pathology, protozoology, bacteriology, or allied subjects in either zoology, medicine, or botany. Applications must be made by letter to the Rector, Imperial College of Science and Technology, Prince Consort Road, S.W.7, by at latest June 11.

AN election of Beit junior memorial fellows for medical research will take place in July next and applications for them are invited. The annual value of each fellowship is £400 and the tenure usually three years. Forms of application and full information may be obtained by letter addressed to Prof. T. R. Elliott, Honorary Secretary, Beit Memorial Fellowships for Medical Research, University College Hospital Medical School, University Street, W.C.1. Completed forms of application should be returned by May 18.

Calendar of Geographical Exploration

March 21, 1699.—Abyssinia via the Nile

A Jesuit, Father de Brèvedent, and a French doctor, Charles Poncet, reached Sennar. They left Cairo in June 1698, went down the Nile to Siout, and then struck across the desert and passed through Dongola to Sennar, reaching the Blue Nile above its confluence with the White Nile. Leaving Sennar, they recrossed the Blue Nile, reached the Gundwa, the headstream of the Atbara, and arrived at the borders of Abyssinia, where de Brèvedent died. Poncet entered Abyssinia, and stayed there until early in 1700, when he returned to Massaua. Poncet's journal gave much information about the regions through which he passed, and especially about their natural history.

March 21, 1871.—Henry Morton Stanley

Stanley's remarkable series of African explorations began on this date with his journey from the east coast of Africa to Ujiji, where he met Livingstone and with him explored the northern shores of Tanganyika. His next expedition, 1874–77, from east to west of Central Africa, resulted in the mapping of the course of the Congo River, in a knowledge of the relation of the Kagera to the Nile, in the discovery of Lake Dweru, and in the solution of many other geographical problems of the region. In 1887–90 he discovered the Ruwenzori Mountains, traced the course of the Semliki River, discovered Lake Edward Nyanza and the great south-western gulf of Victoria Nyanza. Much information about the pygmy tribes of the Congo forest was collected. His journeys outlined the main facts of the sources of the Nile, and completed the work of the earlier explorers of the Nile and of Livingstone and Cameron.

March 22, 1830.—Mouth of the Niger

Richard and John Lander arrived at Badagry, on the Slave Coast of the Gulf of Guinea. They then made their way inland to Bussa, on the Niger River, the journey occupying three months. After careful preparations, they embarked on the river in two canoes and sailed down it to the Atlantic Ocean, thus at last clearing up the course taken by the Niger River. They also found that the Benue River joined the Niger. Their courage in entrusting themselves in such frail barks on an unknown river and in facing the dangers of tropical diseases, hostile tribes, and uncharted rocks, dangers which had already taken toll of many previous explorers, was rewarded by the solution of a problem upon which Mungo Park and Clapperton had worked. It is interesting to note that a 'stay-at-home' geographer, James M'Queen, had fourteen years previously correctly mapped out the course of the Niger on scientific principles, and had proved that it could only terminate in the Bight of Benin.

March 23, 1843.—Middendorf in Siberia

A. T. Middendorf left Turukhansk, went down the frozen Yenisei, and thence over the tundra to the basin of the Khatanga River. He then proceeded northwards to the Taimir peninsula, and, in spite of many hardships, brought back valuable descriptions of the life of the region. Later he journeyed from Yakutsk to the Sea of Okhotsk, crossing the Stanovoi Mountains and exploring the Amur basin as far as Lake Baikal. Middendorf's accounts of the regions he traversed are of great scientific value, especially for the study of the flora and fauna of Siberia.

March 24, 1921.—R. E. Cheesman in Arabia

Major R. E. Cheesman started his exploration of the coast-line of eastern Arabia, near the island of Bahrein, at the Bay of Salwa. The coast between Oqair and Salwa had never been visited by a European, though Burchardt in 1904 passed Salwa on a different route. Cheesman made a route traverse of the coast, accompanied by a sailing boat which carried his chronometer. He was much interested in the ruins of Salwa, which may have been the Phœnician Gerra. In 1923–24 Cheesman explored the desert of Arabia southward from Hofuf, discovering the oasis of Jabrin, previously unvisited. A feature of his work was his record of bird life in the regions which he visited.

Societies and Academies

LONDON

Institute of Metals, March 9.—J. Newton Friend: The relative corrodibilities of ferrous and non-ferrous metals and alloys. (3) Final report. The results of three years' exposure at Southampton Docks. The metals examined included lead, zinc, tin, aluminium, copper, nickel, and various alloys containing iron, chromium, nickel, copper, and zinc. Nickel-copper alloys, particularly the 70:28 alloy, offered great resistance to corrosion. High-grade zinc and tin were slightly more attacked than the less pure metals. Tension, riveting, and cold-working did not appreciably affect the corrosion of nickel-chromium alloy steels, but in every case cracks appeared at welds. Alloy steels resisted corrosion well; they are subject to serious localised corrosion.—**O. F. Hudson and J. McKeown:** The properties of copper in relation to low stresses. The effect of cold-work, heat-treatment, and composition. (1) Tensile and compression tests under short-time loading. The tensile tests have shown that all the materials tested possess a certain limit of proportionality due to the applied cold-work, and that this limit of proportionality can be considerably raised by suitable heat-treatment. There is a superior resistance to deformation brought about by cold-work and suitable heat-treatment, and also a greater resistance to deformation conferred on copper, particularly at elevated temperatures, by the presence of a very small percentage of silver and also by the presence of tin and silicon.—**H. J. Tapsell and A. E. Johnson:** The properties of copper in relation to low stresses. The effect of cold-work, heat-treatment, and composition. (2) Creep tests at 300° C. and 350° C. of arsenical copper and silver-arsenical copper. Improvement in resistance to creep at 300° C. and 350° C. is effected by the special pre-treatment of the alloys, and alloys containing 0·072 per cent silver are superior to the silver-free alloys.—**R. Seligman and P. Williams:** The interaction of aluminium and water vapour. The statement having been made recently that aluminium and its alloys are rapidly attacked by super-heated steam at 300° C., the authors have made experiments and have found that no such attack takes place under the conditions which they define.—**F. Bollenrath:** On the influence of temperature on the elastic behaviour of various wrought light metal alloys. The elastic properties increase with decreasing temperature, except in the cases of two aluminium alloys with a high silicon content.—**D. Hanson and C. E. Rogers:** The thermal conductivity of some non-ferrous alloys. Aluminium-copper alloys were tested, also the effect of aluminium, nickel, iron, phosphorus, and arsenic on the thermal conductivity of copper.—**A. J. Sidery, K. G. Lewis, and H. Sutton:** Intercrystalline corrosion

of duralumin. Partial immersion in a N-1 solution of sodium chloride to which 1 per cent (by weight) of hydrogen chloride had been added was capable of producing intercrystalline corrosion consistently in samples of duralumin where a propensity towards this type of corrosion existed. Overstrain in tension increased slightly the tendency towards intercrystalline penetration, but no relation was observed between this tendency and the degree of elongation. In general, the higher the quenching temperature the smaller was the tendency of the material to develop intercrystalline corrosion.

PARIS

Academy of Sciences, Feb. 1. — A. Cotton, G. Dupouy, and M. Schérer: The magnetic rotatory power of blende and the measurement of the fields of electromagnets furnished with perforated pole pieces. Utilisation of magnetic rotations of thin plates of blende for the measurement of intense magnetic fields.—Gabriel Bertrand: Can gold be considered as one of the elements of living matter? Berg has stated that gold is present in the brain of the ox in the relatively high proportion of 14 mgm. per kilogram of dry substance. The author has repeated Berg's experiments with negative results. If the ignition is conducted in a platinum vessel a trace of this metal, but no gold, is found after following Berg's process, but after ignition in silica there is no trace of either platinum or gold.—E. Mathias: Variation of the surface tension of fulminating material as a function of the temperature and molecular weight.—Ch. Porcher and A. Tapernoux: Search for indoxyl (indican) in cow's milk and goat's milk. A criticism of a recent communication by Ch. Hervieux. The thymol reaction for indoxyl derivatives is not trustworthy.—Paul Bouin was elected *Correspondant* for the Section of Anatomy and Zoology.—Th. Anghelutza: A functional equation.—Gaston Julia: The reconstruction of a σ Riemann surface corresponding to a multiply connexe area $\mathfrak{A}$.—Jean Pierre Robert: Riquier's problem and its generalisations.—M. Ghermanesco: Certain systems of linear partial differential equations of the elliptic type.—F. Leja: The domain of convergence of series of homogenous polynomials.—Edouard Callandreau: The maximum strain in a plane body perforated by a circular hole.—Sonier: Thin rectangular plates submitted to variable forces.—Michel Luntz: The virtual profiles of least resistance.—D. Barbier: The probable periods of visual double stars the orbit of which is still unknown.—Bernard Lyot: The study of the solar corona with the spectroheliograph otherwise than during an eclipse. In a previous communication the author has given an account of how he saw and photographed the green and red lines of the solar corona with a direct vision spectroscope. These experiments have been repeated with two spectrographs of much greater dispersion and with a spectroheliograph. The results described prove that by these methods it is possible to study the green and red lines of the coronal spectrum at any time, and in a more complete and exact manner than during eclipses.—N. Gunther: The Newtonian potential.—A. Schweitzer: The variation of dimensions produced by annealing cold hardened copper.—J. Jaffray: Some properties of vacuum thermocouples. Supplementing an earlier communication, the effect of the variation of the external temperature has been studied and a method of correction worked out.—André Chevallier and Pierre Dubouloz: Intensity measurements in the ultra-violet spectrum by means of photoelectric cells sensitised by sodium salicylate. In an earlier communication the authors have described the application of a potassium photoelectric cell, sensitised by sodium salicylate, to the study of the ultra-violet. It is now shown that the curves obtained giving the intensity of the fluorescent light as a function of the wave-length agree closely with those obtained by other methods.—Mlle. Suzanne Veil: The action of the electric field on gelatine. The effect of the presence of an indicator. Deformations undergone by gelatine in an electric field correspond with physico-chemical changes in the medium.—P. Jacquet: Study of the tensions in electrolytic copper deposited in the presence of gelatine.—René Pallu: Study of the system $H_3PO_4 . Ca(OH)_2 . CO_2 . H_2O$.—T. Karantassis: The action of hydrocyanic acid on the halides of the tervalent and tetravalent metals. The existence of the compounds $TiCl_4 . 2HCN$ and $AlCl_3 . 2HCN$ is proved.—A. Maille and Renaudie: The transformation of ketones into liquid hydrocarbons. Using silica gel as catalyst, ketones (acetone, propione) gave a mixture of aromatic and unsaturated hydrocarbons with a small proportion of naphthalene and anthracene.—A. Wahl and R. Lantz: The preparation of some new derivatives of β-naphthol.—F. Salmon-Legagneur: β-Homocamphoric acid. A new mode of formation of β-camphor.—Émile André and Charles Vernier: The d-ricinoleates of α-phenylethylamine and l-ephedrin.—Dalloni: The Silurian grits and intrusive alkaline rocks of the older formations of Tibesti.—André Demay: The fragments of Hercynian overlapping near Vivarais.—Chadefaud: The chondriosome of the green algæ.—Mlle. Lucienne George: Observations on *Sorbus torminalis*.—Aug. Chevalier: The places deprived of vegetation in the Sahara and their cause from the point of view of plant ecology.—Friant: The influence of the size of the body on the dental morphology of mammals.—Jules Amar: The hydrothermal coefficient in homeotherms.—René Hazard: The action of sparteine on the inversion by yohimbine of the vasoconstrictor effects of adrenaline.—A. Auguet and J. Lefèvre: Curves of loss and of metabolism as a function of the external temperature in the homeotherm in repose.—A. Policard and A. Morel: The utilisation of the spectrography of lines in histochemistry (histospectrography). A modification of the method proposed by W. and W. Gerlach for which some advantages are claimed. — R. Pussard: A parasitic nematode of *Psylla*. — Ph. Lasseur, A. Dupaix, and M. Grojean: Factors of stability of bacterial suspensions heated to 80° C. The remarkable stability of bacterial suspensions after heating to 80° C., is explained, at least in part, by a decrease in the surface tension of the dispersed medium, an increase of the electric charge, and an increase in the viscosity.—Pilod and Codvelle: The action of metallic copper on the germs in drinking water.

LENINGRAD

Academy of Sciences—*Comptes rendus*, No. 10, 1931.—A. P. Vinogradov: Colorimetric determination of vanadium by the method of phospho-tungstic acid. The method, which is described in detail, is particularly suitable for the determination of vanadium in living organisms.—V. P. Rusakov: Radioactivity of phosphorites and their extracts. The average radioactivity of phosphorites exceeds considerably that of more common soils and rocks. The radioactivity of water extracts from phosphorites is very weak, of the order 10^{-12} per cent of radium. The radioactivity of extracts made by 10 per cent solution of hydrochloric acid is, on the average, of the order 10^{-10} per cent of radium.—V. Milchevskaja-Rutkovskaja: Rubidium (and cæsium) in microclines from different localities.—E. Krinov: The meteorite of Staroje Boriskino. Description of a meteorite which fell on April 20, 1930,

65 km. north of Buguruslan.—C. Flerov: Data on the craniology of the family Equidæ. Craniological characters of the recent members of the family are tabulated and discussed. The conclusion is reached that they all form one genus, *Equus*, with three subgenera, namely, *Equus*, including the domestic horse and *E. prewalski*; *Asinus*, comprising Asiatic and African wild and domestic asses; and *Hippotigris*, which includes zebras and quaggas.—B. Galerkin: The flexion of thick elastic plates, rectangular and triangular, poised on their contours. A contribution to a solution of the problem of theory of elasticity in the case of three dimensions, with the aid of functions of tension and displacement.

Forthcoming Events

FRIDAY, MARCH 18

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (Annual Meeting) (at the Middlesex Guildhall, Westminster), at 3.—Chairman: Earl Buxton. Speakers: Viscount Grey of Fallodon and J. H. Whitehouse.

GLASGOW CHEMICAL SOCIETY (Annual General Meeting) (at Glasgow University), at 4.—Prof. G. G. Henderson: Publication of Chemical Literature (Presidential Address).

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Annual General Meeting, followed by an Ordinary Meeting.—A. S. Rao: The First Spark Spectrum of Arsenic (As II).—J. S. Rogers: The Photographic Measurement of the Absorption Coefficients of Gamma-rays from Radium (B+C).—M. Fahmy: On the Derivation of Maxwell's Equations from the Equations of the Quantum Theory.

UNIVERSITY COLLEGE, at 5.30.—Prof. A. J. Toynbee: The Turks (Lecture).

IRON AND STEEL INSTITUTE (Annual General Meeting) (at Royal Technical College, Glasgow), at 7.15.—W. E. J. Lewis: Notes on Autogenous Welding.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea), at 7.30.—Annual Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Lord Rutherford of Nelson: Recent Researches on the Gamma Rays.

SATURDAY, MARCH 19

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (in Botanical Department, University College), at 11 A.M.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—F. C. Boon: Teaching the Method of Ratio (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford of Nelson: Discovery and Properties of the Electron (4).

MONDAY, MARCH 21

KING'S COLLEGE, LONDON, at 5.30.—Prof. Julian Huxley: Impressions of Soviet Russia (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre and West Wales (Swansea) Sub-Section) (at Swansea), at 6.—Prof. J. K. Catterson-Smith: Everyday Uses of Electricity (Faraday Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 6.45.—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Hotel Metropole, Leeds), at 7.15, followed by an Ordinary Meeting, at 7.45.—Dr. C. J. Smithells: Photoelectric Cells and their Industrial Applications.

ROYAL SOCIETY OF ARTS, at 8.—A. E. L. Chorlton: Oil Engine Traction (Howard Lectures) (3).

TUESDAY, MARCH 22

ROYAL SOCIETY OF ARTS, at 4.30.—Dominions and Colonies Meeting.

ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group) (Annual General Meeting), at 7.—E. E. Jelley: A Cause of Yellowness in Sepia Toning.—S. D. Threadgold: The Measure of Graininess.

THURSDAY, MARCH 24

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (Annual Meeting) (at Institution of Engineers and Shipbuilders, Glasgow), at 7, followed by an Ordinary Meeting, at 7.30.—Dr. C. L. Whittles: The Chemist, the Soil, and the Farmer.

Official Publications Received

BRITISH

Proceedings of the Royal Society of Edinburgh, Session 1931–1932. Vol. 52, Part 1, No. 3: Calendar of Hume MSS. in the possession of the Royal Society of Edinburgh. By J. Y. T. Greig and Harold Beynon. Pp. 138. 11*s.* 6*d.* Vol. 52, Part 2, No. 4: The Effect of Malnutrition on Root Structure. By Dr. George Bond. Pp. 159-173+2 plates. 1*s.* 9*d.* Vol. 52, Part 2, No. 5: On the Orthogonal Polynomials in Frequencies of Type B. By Dr. A. C. Aitken. Pp. 174-182. 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 7, Part 1, February. Pp. 144+6 plates. (London: Adlard and Son, Ltd.) 15*s.* net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 1, January. Abstracts Nos. 1-188. Pp. 36. (London: H.M. Stationery Office.) 1*s.* net.

Department of Scientific and Industrial Research. Report of the Forest Products Research Board; with the Report of the Director of Forest Products Research for the Year 1930. Pp. vii+52+10 plates. (London: H.M. Stationery Office.) 4*s.* net.

Proceedings of the Royal Irish Academy. Vol. 40, Section A, No. 5: Electric Discharge from Water Drops. By J. J. Nolan and J. G. O'Keeffe. Pp. 86-98. 6*d.* Vol. 40, Section B, No. 12: A Tectonic Analysis of the Mourne Granite Mass, County Down. By Dr. Herbert P. T. Rohleder. Pp. 160-174. 6*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 15, No. 60, December. Pp. 83-101+259-372+353-587+xxvi. (Sheffield.) 10*s.* 6*d.*

Reports of the Progress of Applied Chemistry. Vol. 16, 1931. Pp. 748. (London: Society of Chemical Industry.) To members, 7*s.* 6*d.*; to others, 12*s.* 6*d.*

Ollsgoil Na h-Eireann (The National University of Ireland). Calendar for the Year 1931. Pp. viii+306+532+238. (Dublin.)

FOREIGN

U.S. Department of the Interior: Geological Survey. Bulletin 834: Bibliography of North American Geology, 1929 and 1930. By John M. Nickles. Pp. ii+280. 45 cents. Water-Supply Paper 675: Surface Water Supply of Hawaii, July 1, 1927, to June 30, 1928. Pp. v+105. 20 cents. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 346: Hyperfine Structure of Mercury, III. By Kiyoshi Murakawa. Pp. 299-306. 20 sen. No. 347: Chemische Untersuchungen in der Saponinreihe. Mitteilung 1: Über das Glucosid von Panax Ginseng C. A. Mey. Von Munio Kotake. Pp. 4. 10 sen. No. 348: Chemische Untersuchungen in der Saponinreihe. Mitteilung 2: Über die Saponine von Kalopanax ricinifolius. Von Munio Kotake und Katsuta Taguchi. Pp. 5-11. 15 sen. No. 349: Carotin and Dihydroergosterol in Green Tea. By Michiyo Tsujimura. Pp. 13-21. 15 sen. Nos. 350-354: On the Enzymes of Chicken Sarcoma, by Eiichi Somekawa; Über den Spinnometer und seine Anwendung, I, von Sin-itirô Iwasaki; Über den Spinnometer und seine Anwendung, II, von Sin-itirô Iwasaki; Syntheses of Chalkone Homologues and related Compounds, Part 1: Methoxy Acetophenone, Methoxy Chalkone and some related Compounds, by Miss Chika Kuroda and Miss Tokiyo Matsukuma; Syntheses of Chalkone Homologues and related Compounds, Part 2: Some Homologues of Methoxy Chalkone and their related Compounds, by Miss Chika Kuroda and Miss Teruko Nakamura. Pp. 23-76. 60 sen. (Tōkyō: Iwanami Shoten.)

Carnegie Institution of Washington. Year Book No. 30, July 1, 1930, to June 30, 1931, with Administrative Reports through December 11, 1931. Pp. xix+63+505. (Washington, D.C.)

Cornell University Agricultural Experiment Station. Bulletin 526: Potato Storage on 259 Farms in New York. By A. L. Wilson and E. V. Hardenburg. Pp. 58. Bulletin 527: The Supply Side of the New York Milk Market. By H. A. Ross. Pp. 151. Bulletin 528: Fermentation and Crystallization of Honey. By Elton J. Dyce. Pp. 76. Bulletin 531: Relative Effectiveness of Limestone Particles of Different Sizes. By T. L. Lyon. Pp. 13. (Ithaca, N.Y.)

CATALOGUES

Oxford University Press General Catalogue, 1931. Pp. 408. (London: Oxford University Press.)

Catalogue of Scientific Books and Publications of Learned Societies. (No. 386.) Pp. 102. (Cambridge: W. Heffer and Sons, Ltd.)

A Catalogue of Book Bargains. (No. 534.) Pp. 16. (London: William Glaisher, Ltd.)

Medical Books, including Surgery, Dentistry, Pharmacy, Sexology, Nursing, Hygiene, Anatomy, Pathology, Ophthalmology. Pp. 62. (London: W. and G. Foyle, Ltd.)

The Microid Physical Series: New Designs in Physical Apparatus, with Experimental Notes. (Catalogue No. 115X.) Pp. 40. Microid Balances and Weights. (List No. GT1031.) Pp. 4. (London: Griffin and Tatlock, Ltd.)