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Science and Social Economics

WHILE the World Economic and Monetary Conference has been sitting, and on many other occasions in recent years, two of the main problems which have presented themselves for solution are those of over-production and unemployment, for both of which science and machinery are held responsible, explicitly or implicitly. It is human to try to find a scapegoat to bear the blame of our own faults; and to the literary mind, science has so much in it that is sinful and prone to evil, that there is no difficulty in discerning its devastating influence upon civilisation, whether in times of peace or of war. The attitude is that of Ruskin's brutal and unjust words: "The advance of science cannot be otherwise recorded than by the invention of instruments to kill and put down noble life."

We have urged over and over again that men of science should dissociate themselves from the use of their discoveries in chemical and other lethal weapons of warfare, but that is not the particular application of science to which we wish now to refer. What we have in mind are the industrial and commercial results of science and invention, and the economic and social problems raised by them. When science makes a dozen blades of grass grow where one grew before, or provides every citizen in a modern community with power equivalent to fifty or more slaves at his beck and call, it has done something to earn human gratitude; and if these gifts are not used for the comfort and welfare of mankind, then the cause must be looked for in the economic system of modern life.

The social difficulties brought about by the use of machinery which displaces manual labour, and so causes unemployment for a time, are by no means new. Little more than a century ago, an appeal to the nation made by a body called the "General Association" might be a manifesto published at the present time by the Labour Party or other group of social reformers. The memorial disclaimed any wish to oppose the advantages derived from machinery and scientific advances, but deplored the growth of a system by which manual labour was so much superseded, and the power of production so astonishingly increased, and yet the means of consumption by the majority of the people diminished.

The social conditions of Great Britain were then in a state of transition as they are now. The

principal occupation of the nation was rapidly changing from agriculture to manufacture, and the system in which spinning and weaving were carried on in the domestic life of rural surroundings had given place to the depressing factory system in which the workers became parts of the industrial machine. Many people, then as now, wished that a good deal of machinery had never been brought into existence, and looked back with wistful longing to the time when each cottage had a spinning wheel at its door. To attempt to restrain the advance of science and invention, or to do anything to regulate the rates of wages, was, however, regarded by the statesmen of the day as impolitic and impracticable; so while wealth increased and the means of production were multiplied many times, wages diminished and distress became more common than before. Then, as now, the monetary system was frequently under discussion and some politicians believed that all the troubles of the country were due to the establishment of the gold standard of currency.

Most of the machinery which now performs a large part of our industrial work, and is supposed to have led to unemployment, did not exist a century ago, yet the poverty of the labouring classes was even greater than it is to-day. The population of Great Britain was then only sixteen millions, yet there were two millions in workhouses or receiving 'outdoor relief'. The terrible conditions of those days were bitterly described by Carlyle in "Past and Present". "We have," he wrote, "more riches than any Nation ever had before; we have less good of them than any Nation ever had before. Our successful industry is hitherto unsuccessful; a strange success if we stop here! In the midst of plethoric plenty, the people perish; with gold walls and full barns no man feels safe or satisfied. Workers, master workers, underworkers, all men, come to a pause; stand fixed, and cannot further."

If such were the human fruits of the industrial revolution, it is little wonder that resentment should have been felt against life-destroying applications of science, and that even to-day the suggestion should be made to call a halt to discovery or mechanical improvements which increase production at the expense of labour. A distinction should be made, however, between inventions and machinery which cheapen the production of known commodities and tend, subject to certain reservations, to displace labour, and scientific discoveries which create new demands and absorb labour. While invention deals with means, tools, machines, and appliances, science is concerned with principles, out of which may come the mastery of Nature in the service of man. From Faraday's discovery of the principle of magneto-electricity has developed the whole of the electrical engineering industry, which directly or indirectly has provided employment for millions of workers, and chemical science has been equally productive in the use it makes of human power and knowledge.

Discovery and invention have created abundance by multiplying man's power of production and increasing the fruits of the earth, facilitating their quick transport, and establishing easy communication between the peoples of the world, so that civilised man could, if he wished, now make the world one instead of a number of conflicting parts in which the World Economic Conference seems to be unable to secure any substantial co-operation. Science has given the world everything required for the maintenance of a growing population in a rising standard of comfort, but, as Prof. Henry E. Armstrong pointed out in his letter in our last issue, there seem to be no true scientific principles or invariable standards, in economic fields; and international agreements are mainly adjustments of national interests conceived in confined political atmospheres and determined by expediency. While this spirit prevails, the prospect of finding a formula which will unite the peoples of the world for industrial and commercial progress and their general welfare, seems almost hopeless.

The political economists to-day are, indeed, no more helpful than they were a century ago, when the same problems of over-production and unemployment were under discussion. In those days the mechanisation of transport and industry was but in its early stages, yet the proportion of unemployed was much greater than it is now. There is thus little justification for laying at the feet of mechanical inventors the burden of unemployment accumulated in recent years. The times of which Carlyle wrote were those of the stage coach and sailing ships, when a multitude of things were done by manual labour which to-day are done by machinery. When first introduced, new machines, it is true, do tend to displace labour in one direction, only however to stimulate it in another, and in the end greater wealth is created, which ought to mean that the community is also profited. For a people to be

made wretched in proportion to the increase of means of producing plenty shows that there is something radically wrong in industrial or social economics.

It is, of course, natural that Labour, with its memory of bitter struggles against long hours and low wages, should stress much more acutely the problem of distribution of the products of its toil than that of the factors of industrial progress. The workman has had good reason for regarding every labour-saving device as a wage-saving device; and it is almost a mockery to suggest to men who find themselves unwanted through the introduction of particular machinery that the ultimate effect will be increased employment. The thought, however sound it may be in industrial economics, affords poor satisfaction for present needs. Men thus displaced through no fault of their own may rightly claim, on the grounds of humanity alone, that the community which is eventually to benefit by the saving in costs of production should accept a measure of responsibility for their maintenance.

Progress in physics and chemistry has indeed profoundly altered those social conditions which it is the purpose of social science to study. In an age when nearly all the problems of administration and development involve scientific factors, the nation cannot afford to leave administrative control in the hands of those who have no first-hand knowledge of science. Modern technical achievement and scientific thought foreshadow a new economic structure for society in which they should be used to exercise decisive influence upon the major policies of the State as well as upon their administration.

It is altogether useless to attempt to repress scientific discovery and its application to invention, but the State should see that the advantages derived from machinery and scientific improvements are justly shared by all and not used to enrich the few to the sacrifice of the many. In political realms men of science have no place; and it is to statesmen that the community has to look for the solution of the national and international problems brought about by superabundant production due to the advance of scientific knowledge and its use in industry. The time has come for the civilised world to readjust itself to meet the new conditions if it is to be saved. Whether men will prove themselves worthy of the argosies of science which will enter their ports, is not for us to predict, but upon the result will depend the future destiny of the human race.

The Works of Huygens

Œuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome 17: *L'Horloge à pendule de 1651 à 1666; Travaux divers de physique, de mécanique et de technique de 1650 à 1666; Traité des couronnes et des parhélies (1662 ou 1663).* Pp. iv + 551 + 7 plates. (La Haye: Martinus Nijhoff, 1932.)

THE appearance of the seventeenth volume of the works of Huygens marks another welcome stage towards the completion of a monumental task. Editors and printers alike have continued to spare no pains to make this publication a memorial worthy of the great Dutch physicist. A French translation is set alongside the Latin or Dutch original, and the text is accompanied by introductions and a full apparatus of historical notes. These are the more valuable because Huygens is not merely a great figure in himself, but also because, maintaining contacts with the contemporary world of science, he stands as the great link between the age of Galileo and Descartes and that of Newton. For this reason, the present edition of his works, when complete, will provide indispensable material for the history of a most important period in the development of physics, apart from the light thrown on the achievement of one outstanding man.

The volume most recently issued falls into three distinct sections. Of these the first is devoted to the work on clocks, the third contains the memoir "De Coronis et Parheliis", while the shorter intermediate section brings together a number of minor papers on physical subjects written between 1650 and 1666. The latter year closes the decade to which the development of clocks and the researches on meteorological optics in the main belong.

The interest of Huygens in the pendulum dates from the year 1646. His discovery of the fundamental formula for the period was communicated in the form of an anagram to the Royal Society in 1669; apart from this, it was kept secret from 1659 until 1673. Thus when he turned his attention to the practical problem of clocks in 1656, Huygens was resorting to a principle which had been familiar to him for some years, but for which he was still seeking a precise statement.

The clockmaker's art had reached a high pitch of development, and as machines consisting of toothed wheels and balances, actuated by falling weights, the products of artists like Salomon Coster of the Hague fairly satisfied domestic

requirements. They fell far short, however, of satisfying the needs of astronomy. On the other hand, from the days of Galileo onwards, laborious efforts had been made by astronomers to take advantage of the isochronism of the freely swinging pendulum. What Huygens, actuated by the scientific need for clocks of precision, did, was to combine the scientific principle with the existing technique by using the freely suspended pendulum to control the mechanism which had been long understood. The idea in essence was as simple as it was valuable. It could be applied to existing clocks, and the clock of Utrecht Cathedral, for example, was thus adapted. Clockmakers readily seized on the new horological principle; thus pendulum clocks were made in Oxford so early as 1659.

One cannot fail to admire the ingenuity and simple directness with which Huygens applied himself to what must have been at the time a pressing need. In other directions he was less fortunate. Knowing that the period was not independent of the amplitude, he sought from the first to secure perfect isochronism by confining the motion of the suspension between controlling surfaces. The form of the surfaces was determined empirically, and the plan for various reasons failed in its purpose and was abandoned. Later, when he was in possession of the properties of the cycloid, the same plan was resumed, but apparently with no greater success than before. The idea remains a pretty theory and nothing more.

The second problem attacked was the determination of longitude at sea. In this case the belief of Huygens that a solution could be found in the transport of pendulum clocks shows a boldness only to be justified by the extreme urgency of the problem. This aspect of the position is well illustrated by the incident which flattered Huygens' hope of success. Four English ships under Holmes found themselves short of fresh water in mid-Atlantic. Should they sail east or west? Holmes, trusting to his clocks designed by Huygens, turned east, found the hoped-for island and disaster was averted. Others, however, and Pepys was among them, shrewdly conjectured that good fortune had played a larger part than science in this episode, and navigation had still to wait for Harrison before a satisfactory time-keeper for marine use was invented.

The shorter papers on a variety of physical subjects, hydrostatics, gravity, light and optics, are of great interest. Here, for example, is a description of Newton's rings dating from 1664, about the time when Newton was first turning his youthful mind to optical questions and Hooke's "Micrographia" appeared. The work on the air pump illustrates the manipulative skill of Huygens admirably, and suggests a further comment on his efforts to produce an exact instrument for the measurement of time. Had he abandoned the attempt to render the period of the pendulum independent of the amplitude and turned his attention to the means by which the amplitude could be made constant, he was actually in possession of the chief elements for a solution of the problem on modern lines.

The considerable memoir "De Coronis et Parheliis" appears to have been completed about the year 1663. It was not published by the author, but forty years later it was included in his "Opuscula Postuma". In the present edition it is followed by fifteen appendices or short notes made or collected at various dates. It may be inferred that Huygens was not altogether satisfied with the treatise, and perhaps it is not very important. Its chief interest lies in the desire, evident in Huygens as in Descartes, to bring all phenomena under a rational scheme of Nature; the success of such endeavours is to be measured not so much by a perfect accuracy of scientific detail as by the growing triumph over the lingering traces of popular superstition. H. C. P.

Alchemy and the Alchemists

The Lure and Romance of Alchemy. By C. J. S. Thompson. Pp. iv+249+31 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1932.) 5*s*. net.

THE remarkable exploits of the 'alchemist' Tausend in Germany in 1929 show that, in spite of the spread of education in science, the lure of alchemy is still sufficiently strong to cast a spell over the most level-headed and matter-of-fact men if presented in a plausible way. The history of so persistent a delusion is consequently a matter of considerable interest, not merely to the student of scientific origins, but also to the general public. The average reader will find his requirements adequately catered for by Mr. Thompson, who is widely known as an enthusiastic seeker after the curious and bizarre in the development of science and medicine. His extensive reading and easy style, which made his earlier

books so attractive, again show to advantage in his delightful account of the rise and progress of alchemy and of the fortunes—or misfortunes—of the most celebrated adepts. Mr. Thompson has a *flair* for the picturesque, and knows how to relate an anecdote; at the same time, he appreciates the main trend of alchemical evolution, so that his narrative unfolds itself in a manner that is both titillating to the attention and satisfying to the intelligence. Add to this the fact that the book is well illustrated, with carefully chosen and excellently reproduced figures and plates, and it will be evident that Mr. Thompson should be sure of numerous readers.

Yet the fact that this book is likely to achieve a wide circulation makes us regret all the more keenly that, unfortunately, it abounds in error of detail. Everyone who has written a manuscript or corrected a proof knows that perfect accuracy is, alas, unattainable; but Mr. Thompson has allowed an unusually large number of mistakes to elude his vigilance. Some of those that we have noticed are as follows: A. S. Ridgrove for H. S. Redgrove; Tabula Smaragdini for Tabula Smaragdina (p. 31); Zosimus is placed a century too late (p. 43); D. S. Johnson for O. S. Johnson (p. 49); Jābir was certainly never associated with Khālid (p. 59); the year of Razi's birth (866) is not "unknown", and he died on October 26, 925, not "between the years 903 and 923"; Muwaffah should be Muwaffak; Maslaman should be Maslama; the queer name Lhocine Toughrai (p. 66) is presumably Al-Ḥusain al-Ṭughrā'ī; Abri'l-Quasin should be Abu'l-Qāsim; the house where Thomas Norton [is said to have] lived at Bristol is not "still standing"; "litarge" (p. 105) is not "white lead"; the earliest edition of the "Triumphal Chariot of Antimony" was published in 1604, not 1685; and Boyle's *magnum opus* was entitled "The Sceptical Chymist", not "The Skeptical Chymist". There seems no reason, moreover, for retaining such antiquated names as binoxide, oxyacetate, sulphuret, antimonium, tartarated antimony and protoxide, most of which would be incomprehensible to the modern reader. Such remarkable statements as that "the Moors acquired some knowledge of alchemy from Arabia as early as the twelfth century", and that van Helmont "classified gases as flammable and inflammable", are doubtless to be explained—like many of the other errors—by hurriedness in writing and a superficial reading of proofs; but they must prove irritating to well-informed readers and misleading to those who approach the subject for the first time.

We hope that Mr. Thompson may have an opportunity of revising his book, for it is distinctly attractive and, by the exercise of more care, could be made excellent. The best sections are those that deal with the adepts of the sixteenth and seventeenth centuries. Here Mr. Thompson is obviously more at home with his authorities, and relies less on secondary sources of information. Had he maintained the same standard throughout, his book would have been a valuable contribution to the history of alchemy; as it is, we can only regret that what is good is not—as it might easily have been—so very much better.

E. J. HOLMYARD.

The Plant Cell in Biology

Traité de cytologie végétale. By Prof. A. Guilliermond, G. Mangenot and L. Plantefol. Pp. ix+1195. (Paris: E. Le François, 1933.) 250 francs.

THE cells of plants and animals, on account of the variety of their constituents, are subject to many different kinds of analysis. All the constituents can be studied physically and chemically; all, even the usually structureless cytoplasm, can also be studied morphologically; and hence from developmental and systematic comparison they can be considered in regard to their genetic and physiological properties. Thus all the different kinds of technique and processes of inference known to biology have been applied to the cell, and it is clear that no attempt can yet be made to integrate the diverse body of data that has accumulated. On the other hand, it is equally evident that the student who is attempting a particular type of analysis in plant cells is not merely able to take into consideration the same kind of analysis in animal cells, but he is compelled to do so, if he is to arrive at any sound generalisations. Any separate account of plant or animal cytology must therefore be descriptive rather than inductive.

M. Guilliermond and his collaborators have written such an account, and their work is the most ambitious attempt that has yet been made to summarise the whole body of information on the plant cell. The authors have compressed into one volume an account of every aspect of the study—nuclear and cytoplasmic; morphological, developmental, biochemical and genetic. The

result is necessarily heterogeneous. The cytoplasmic constituents—chondriosomes, plastids, vacuoles and metabolic products—an accurate knowledge of which we owe in large measure to M. Guilliermond's own brilliant investigations in all groups of plants, are described in detail both in their morphological and developmental properties. The general conclusion that plastids and chondriosomes have a separate genetic continuity throughout all plants possessing them is supported by a wealth of evidence and is shown to be the simplest, if not by any means a final, generalisation from the available knowledge, taking into consideration that derived from animals. The account of plant histology and the morphology of the reproductive systems is detailed and accurate, and each subject is introduced with an excellent historical summary.

The treatment of the biochemical and genetical elements of the subject is less fortunate. The biochemistry is introductory and not comparable in accuracy or completeness with the cell morphology. The nuclear cytology is curiously compounded. Combined with a very detailed description of certain recent hybrids is a general account of meiosis in which little reference is made to work published in the last ten years in other languages than French. Mitosis is spoken of as arising from amitosis and no mention is made of Bělař's critical review of this subject published in 1926. The crucial cases of *Primula sinensis* and *Œnothera* still appear in the rôles of unsolved mysteries, although they lost this character in 1929. The observations and hypotheses of twenty and thirty years ago are brought back to life and made to play their almost forgotten parts. It will be indeed surprising to some authors to see resurrected the figures which they had thought long buried. The evidence from breeding work which proves the inheritance of cytoplasmic bodies is treated almost casually. No mention is made of the two most important contributions to this study, those of Correns and F. v. Wettstein. Yet this evidence provides the sure key to the question of the genetic continuity of cytoplasmic bodies, and had the authors taken it into account they might have avoided occasional hesitation between "sont incapables" (p. 62) and "paraissent incapables de se former *de novo*" (p. 81).

Similarly, inconsistencies are not noted between genetical and cytological accounts of the same event. The zygote nucleus in the teleutospore of the Ustilaginales is supposed to divide meiotically "malgré l'absence d'observations certaines". Yet Dickinson has shown segregation following these divisions, an observation which leaves no doubt of the occurrence of meiosis. Moreau is said to have shown parthenogenesis in many Ascomycetes, although in the same species fertilisation has been shown cytologically by Claussen and heterothallism genetically by Dodge. The important work of Buller on diploidisation and other problems is scarcely mentioned and does not appear in the bibliography —which is, in general, very irregularly compiled.

These points show the weakness of the method of approach, for they are the ones in which the co-ordination of animal and plant research and of the cytological and genetical techniques is at once easiest and most essential. The attempt to examine problems individually impairs the coherence of the argument and the finality of its conclusions. One must therefore regret that M. Guilliermond and his collaborators have not followed the example of those German and American writers whom they criticise, in confining their attention to those branches of the subject in which they speak with acknowledged authority. The book, however, will be indispensable to workers in M. Guilliermond's field.

C. D. DARLINGTON.

Short Reviews

Vitamins and other Dietary Essentials. By Dr. W. R. Aykroyd. Pp. vi+218. (London: William Heinemann (Medical Books), Ltd., 1933.) 7*s.* 6*d.* net.

MERE lucidity is rare enough in works on nutrition to merit favourable notice whenever it is met. Dr. Aykroyd gives his readers even more than that; an urbanity of manner, a wittiness of phrase, an erudition extending far beyond the confines of his subject matter, that make his book a model, a far from easily copied model, of how a scientific work intended alike for scientific and lay readers can and should be written. In the compass of two hundred odd pages he makes by far the most satisfactory, well-balanced, and practically useful survey of present-day knowledge of human nutrition and its relation to health and disease that is available to the English reader. On the side of dietetic constituents he treats of calories, protein requirements, carbohydrates and fats, and vitamins A to D (for some reason, probably because its relation to human nutrition is not yet under-

stood, omitting E); and on the medical side he gives precise and readable accounts both of the events leading up to and of the content of modern knowledge about beriberi, pellagra, scurvy, osteomalacia, rickets, and most of the states of physique and health now known to depend in greater or less measure on nutrition.

"Vitamins and Other Dietary Essentials" is not, to be fair, a book from which the medical practitioner may get dogmatic guidance on what diet he should prescribe in this case or that: that is a purpose for which he must turn to such a standard work as Hutchinson and Mottram's "Food and the Principles of Dietetics". But if he wishes to learn the scientific principles that should determine the choice of a diet and the criteria in terms of which a given diet may be judged, he could do no better than read this book from cover to cover. M. N.

Atomic Reactions. By Prof. Michael Polanyi. Pp. 64. (London: Williams and Norgate, Ltd., 1932.) 6*s.* net.

WITH the advent of the wave mechanics, a more definite interpretation of the energy of activation of a chemical reaction has been given to us. The interpretation is more intelligible in the sense that, apart from a change in terminology, energies of activation being now regarded as heights of the energy barrier between two states of a composite system, the theories of Heitler and London permit us for the first time to predict at least in simple cases the magnitude of the energies involved. The fundamental simplicity of atomic reactions suggests that in these should be found a wealth of material for confirming and extending the theoretical basis.

Prof. Polanyi's name is intimately associated with atomic reactions and there exists no clearer presentation of the present position of the theoretical framework as well as of the experimental technique and results than is contained in this short volume, by the chief investigator in this field. The book is divided into three sections; the first containing an excellent survey of the theory of chemical reactions and the two subsequent sections devoted to atomic reactions including those which do not and those which do require energies of activation. This is really an excellent book and it is to be hoped that the publishers may see their way to bring out a very cheap edition so as to render it more accessible to the general and now impoverished reader. E. K. R.

Surveying. By Prof. W. Norman Thomas. Third edition. Pp. viii+552. (London: Edward Arnold and Co., 1932.) 25*s.* net.

THIS treatise on surveying has gone through three editions and deals with the subject in all its branches. It is up to date and well arranged. Where recent instruments, such as the prismatic astrolabe, are not described in detail, references are given to books and papers where full descriptions can be found.

The author, who is not only an instructor in surveying, but also a practical field surveyor, rightly lays great stress on the uselessness of theory unless accompanied by field work. The examples of the application of surveying to engineering work, which the author gives, show that he constantly keeps this necessary principle in mind. In these examples a great deal of practical information is set out taken from work done in different parts of the world.

Another useful feature of the book is the working out in full of problems illustrating how the different formulæ should be handled. This we consider of great importance in a handbook, for the engineer often finds himself confronted with cases which he may not have considered since his student days—here he is given means of refreshing his memory.

Numerous problems are also set in connexion with the contents of each chapter, the answers being given at the end of the book.

H. L. C.

Wechselwirkung zwischen Röntgenstrahlen und Materie in Theorie und Praxis (Röntgentagung in Münster 1932). Herausgegeben von Prof. Dr. J. Eggert und Prof. Dr. E. Schiebold. (Ergebnisse der technischen Röntgenkunde, Band 3.) Pp. vii+211. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 18.80 gold marks.

THE first section of this book contains a series of reports on various aspects of the theory of the interaction of X-rays and matter, by such authorities as Prof. Debye, Prof. Heisenberg, and Dr. R. W. James, to mention only three of the distinguished contributors. The second and much the longer section deals with recent advances in technique, and in particular with the production and utilisation of very high voltages. Adequate bibliographies are appended to all the contributions, and the technical articles are illustrated by numerous photographs and line drawings.

The Technique of Ultra-violet Radiology. By Prof. D. T. Harris. (Blackie's "Technique" Series.) Pp. viii+166+13 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1932.) 6*s.* net.

THE author has collected and condensed into a very brief compass a considerable amount of information of value to workers with ultra-violet light. Most of the practicable methods of generating and measuring ultra-violet light find mention in the book, and although the space available is too brief to allow of much detailed description, adequate references direct the reader to sources of further information. The liberal use of diagrams throughout the book materially increases its value. A short chapter on ultra-violet therapy conveys some useful warnings to workers who are not primarily interested in this particular application of the radiation.

Experimental Production of Malignant Tumours*

By DR. J. A. MURRAY, F.R.S., Director, Imperial Cancer Research Fund

THE investigations of the last thirty years have proved that the cells of the higher vertebrates, under appropriate conditions, are capable of unlimited proliferation, and it is of importance in discussing the problems of experimental carcinogenesis to remember this fact, and to have clear ideas of the characteristic features of the proliferation of new growths, including cancer. This is very necessary because nothing is commoner in the literature of the subject than loose statements that this or that agent confers on the cells powers of unlimited proliferation, which is nonsense, seeing they already possess these powers.

The essential feature is the uncontrolled or autonomous character of the cellular proliferation; that is to say, the agencies which are effective in the body in limiting the rate and amount of growth and cell division are ineffective against true new growths. This is true of both classes of new growths, the benign as well as the malignant. Examples are seen in the fatty tumours, lipomata, which go on increasing in size in an emaciated individual, and the uterine myomata which grow progressively even after the menopause while the ordinary uterine muscle is shrinking or quiescent. The malignant new growths, carcinoma and sarcoma, exhibit this feature still more clearly because many show a more rapid rate of growth.

The other distinctive features of the malignant as contrasted with the benign new growths are differences in degree, rather than in kind, and their more perfect independence or autonomy, manifests itself in infiltrative progress, disorganising and destroying the normal tissues encountered, by pressure from without, or occlusion and rupture of blood supply. The stretching and tearing of the walls of blood and lymph vessels open the way for the entrance of smaller or larger aggregates of the parenchyma cells into the vessels and these, transferred to remote situations, further exhibit their independence and adaptability to new surroundings by the formation of secondary centres of growth, or metastases. It is these manifestations of neoplasia which render cancer so formidable a problem in treatment.

These new proliferative conditions arise in limited localised foci and once they have reached a size sufficient for recognition, further increase takes place only from the descendants of the already transformed cells without fresh accessions from the surrounding elements of the same kind. The original focus may be solitary, or several foci (all minute) may appear almost simultaneously, and soon fuse into one tumour. One type of cell only acquires these new properties and by its multiplication gives rise to the new formation, so that it is usually possible by microscopic examination to infer the tissue of origin, even after the tumour has reached a great size.

The growths of any one tissue do not reproduce the full characters of the differentiated tissue of origin to the same extent. They form a continuous series ranging from apparently perfect reproduction of the histology of the parent tissue to a condition in which no specific differentiation can be recognised at all. Much unnecessary ink has been spilt in devising suitable words to describe this 'undifferentiated', 'dedifferentiated', 'anaplastic' or 'embryonic' state, but what is worth emphasising is the fact that the degree to which it occurs is relatively fixed in any one new growth, and is maintained practically unaltered throughout its course. The rate of growth shows a similar uncorrelated series of gradations and there is much evidence to show that this also is (or at least may be) an initial, inherent, quality of the essential constituent parenchyma cells.

Many of the ideas and conclusions in the preceding summary have obtained a welcome precision and validity from the study of the transplantable malignant new growths of the mouse and rat during the past thirty years. In consequence we may now, with some confidence, define the new growths as single tissue proliferations arising in a localised area, growing from their own resources in an uncontrolled manner, showing a continuous graduated series in those arising from any one tissue, both in histological structure and in rate and habit of growth. In spite of this great range, any one variety is relatively permanent. Descriptive convenience has determined the order in which these characters are enumerated as I find it impossible to give them marks indicating relative importance. We are still without explanation of the process which embraces all these characters and it is hazardous (to me impossible) to accept a hypothesis of the nature and origin of new growths which omits any of them from its ambit.

The necessity, here indicated, of keeping in mind several nearly independent biological processes is common to many pathological problems. It prevents that artificial simplification of the material, which has been so powerful an instrument in the advancement of the physical sciences, and to a considerable extent of physiology.

The attempted solutions of the problem of the nature and causation of malignant new growths, carcinogenesis, may be discussed here in three groups, namely, (1) the genetical hypothesis originating with Boveri, and modified by Bauer; (2) the virus hypothesis particularly associated with the names of Borrel, Rous and Gye; (3) the special form of the chronic irritation theory of Virchow which has arisen on the basis of the work of Yamagiwa on the experimental production of tar cancer.

Boveri's hypothesis was an outcome of his well-

*Opening address at a discussion at the Royal Society on June 15, to appear with other papers contributed to the discussion in *Proc. Roy. Soc.*, B, **113**, 268, August 1933.

known studies on the development of dispermfertilised echinoderm eggs. Boveri had shown that the haploid number of chromosomes or any multiple of it was compatible with normal development. He ascribed the pathological development of these disperm eggs to chromosome defect, one or more of the four primary blastomeres having received an incomplete set of chromosomes from the multipolar first segmentation division.

Direct observation on cancer cells showed that a constant abnormal chromosome number was not found in any one new growth, and the hypothesis was accordingly modified by assuming an invisible, partial, damage to individual chromosomes. The necessity of assuming a haphazard origin from multipolar mitosis retreated into the background, Boveri's own attempts to initiate malignant new growths by this means having failed. It was an easy step to shift this assumed damage to the genes, the invisible chromosome constituents bearing the hereditary factors. This assumption made the hypothesis practically invulnerable by withdrawing it from the possibility of experimental proof or disproof. The main objection to it now is the necessity involved of assuming a large number of constituent units in each gene, to allow for the great number of slight modifications presented by the new growths of any one tissue, all practically permanent.

The modern discussion of the virus hypothesis revolves around the study of the filterable tumours of the domestic fowl first discovered by Rous. Rous himself described four strains of sarcomata, all transmissible by cell-free filtrates, and many pathologically distinct. Subsequent workers, according to a recent review by Murphy, have brought the number up to thirty. Their most remarkable feature is the biological and histological constancy of the growths propagated by cell-free filtrates and the multiplication of the active constituent of the filtrates, during growth in the susceptible animal. While the latter character points to a living, self-reproducing agent, or virus, the variety of stable strains, each requiring a slightly different virus, has proved too much for many workers, and an enzyme-like derivative of the cell protoplasm has been imagined to surmount this fence.

Gye's genial conception of a factor derived from the host cells and carrying all the specific distinctive characters of the tumour strain, acting in conjunction with a relatively non-specific virus, is still without direct experimental proof. Like the enzyme modification, the greatest obstacle to its acceptance is the failure to demonstrate cell-free transmission in the laboratory strains of mouse and rat tumours. Until this is accomplished, it is dangerous to transfer conceptions arising out of the study of the filterable new growths of the fowl to the elucidation of the nature and causation of the new growths of other animals and man. On the other hand, the similarity in behaviour of the filterable tumours to the new growths of mammals imposes the necessity of investigating them, until the nature of the agent is elucidated and its mode of action, so different from that of the majority of viruses, is explained.

The experimental confirmation of Virchow's chronic irritation theory in the last twenty years, has established its validity as a concise description of the emergence of cancer after prolonged, localised slight irritation of the tissues by a variety of agents, and nothing more. Wide differences of opinion still find expression as to how this result is brought about.

The course of a typical experiment of tar cancer induction in mice is as follows: If 100 mice be painted twice weekly on a small area of the back, the following series of changes are observed. In the first two or three weeks the hair hypertrophies and becomes thicker and longer on the painted area. The hypertrophied hairs then fall out and are not replaced and the tarred area becomes hairless and remains so. If the skin at this stage be examined microscopically, the covering epithelium is found to be thickened, the sub-epithelial tissues show a variable amount of increased cellularity and infiltration with lymphocytes, mast cells, and a few polymorph leucocytes. In the deeper layers, sometimes even below the panniculus carnosus, the tips of hypertrophied hair follicles are found, but these ultimately disappear as painting is continued. After 12–16 weeks, localised thickenings of the squamous epithelium appear as discrete warty prominences in the otherwise smooth skin surface. One or more of these increase in size and project above the surface as warty outgrowths. Microscopically they have the structure of benign papillomata and if painting is now stopped they may either (1) disappear completely, (2) remain as warty papillomata for a long time, slowly increasing in size, or (3) after a variable length of time, begin to grow more rapidly, becoming adherent to the surrounding skin and deeper tissues. Their further progress is continuous and the growths manifest all the features of cancer both to the naked eye and microscopically. The death of the mouse follows in 6–8 weeks and, after death, metastases may be found in the nearest lymph nodes and in the lungs, occasionally in other internal organs. In a certain number of animals, the proliferative condition is malignant from its first appearance, without the apparently benign intermediate stage.

We have not yet any method of distinguishing the papillomata which will remain quiescent from those destined to undergo the further progressive malignant development, and in consequence, during the remainder of the time of observation, more and more of the apparently benign warts pass into the third (malignant) group, until after 12–15 months all the mice have developed tar cancers with the exception of a few which still bear simple warty papillomata and one or two in which no proliferative changes have occurred at all. The same succession of changes follows the intermittent long-continued application of a number of different chemical substances, some related to coal tar, others not.

The processes involved are apparently the same as those responsible for the development of several forms of industrial cancer, and the experimental work has provided a secure basis for the incrimination of tar, shale oil, soot, and arsenic in the causation of the corresponding industrial cancer. In addition, other chemical substances exuded by animal parasites, and physical agencies such as cold, ultra-violet light, X-rays and radium radiation can replace coal tar. The preliminary silent period and successively appearing growths as the applications are continued, are exhibited by the intentional and unintentional experiments alike. They furnish a simple, natural, explanation of the age incidence of cancer, a feature which formerly seemed mysterious.

While the constancy of the results of such experiments and the frequency and restriction of certain cancers to those following definite occupations involving exposure to the same substances fully justify the naming of them as *carcinogenic*, it does not take much reflection to see that the essential nature of cancer and the cellular changes involved remain unexplained. Although the agents are applied uniformly over a considerable area, the cancerous process appears only in localised foci and not diffusely. Even in those cases in which a diffuse origin throughout a whole organ is encountered, it is almost certainly due to close juxtaposition of many minute foci and not to a spreading involvement of adjacent unaffected cells.

The chemical and physical carcinogenic agents, in my opinion, act indirectly; they set up conditions in the tissues such that, as a new departure, here and there cancerous foci are started. The chemical properties of these agents give no indication of how the autonomous, uncontrolled type of proliferation is induced, indeed they are so varied that it is difficult to see how they can give any definite indication of the nature of the cellular mechanism involved. Until this difficulty is at least partially obviated, it seems unnecessary to indulge in the further speculation, that the less precisely known carcinogenic agents, secretions of animal parasites, application of cold, X-rays, etc., produce this effect by liberating in the tissues substances more or less closely related chemically to one or other of the pure substances with carcinogenic action.

From this brief summary it is clear that the experimental induction of malignant growth reproduces perfectly the phenomena which occur in the development of occupational cancer from exposure to tar or X-rays, for example. The other forms of cancer for which no definite irritant can be identified at present are so similar in their mode of occurrence and the length of time necessary for their appearance that it is reasonable to accept the facts of experimental carcinogenesis as a model of the genesis of the others also. An attempt has been made to indicate directions in which difficulties still remain. The definition of these difficulties, and the material and methods by which they are being attacked, we owe to the modern development of experimental carcinogenesis.

Art and Mythology in Asia

IN popular estimation, 'mythology' is a term appropriated to legends and traditions concerning the gods and spiritual beings of religions other than Christianity and its forerunner, the religion of the Hebrews. Such a discrimination is apt to give an entirely wrong impression of the place held by a body of tradition in the life and thought of a people. Yet the term is not without its convenience, provided that it is understood that, in spite of much that in our judgment seems trivial, irreverent or even worse, these traditions stand in the same relation to the religious feelings of the people among whom they are current, as the sacred writings to the emotions of those who profess what are commonly regarded as the higher religions.

It is as understood in this sense that the term has been used in the title "Asiatic Mythology" under which a publication has appeared recently, a translation from the French, which is the result of a collaboration among the members of the staff of the Musée Guimet, that treasure house in Paris of objects illustrative of the religion and art of the Orient*. In this work the religious conceptions of Persia, India, Tibet, Further India, and Indonesia, Central Asia, China and Japan have been reviewed, more particularly in so far as they have been embodied in works of art—paintings and sculpture—not only to present the form and attributes of gods and spirits, but also to depict scenes from their sacred story. The objects which have been chosen for reproduction to illustrate and expand—for this is what they really do—the texts of the distinguished collaborators are mostly taken from the choicer specimens in the museum, though some are from the Louvre, and might in themselves alone afford no inadequate introduction to the religious and artistic concepts of the parts of Asia with which the authors deal.

It is appropriate that this survey of Asiatic mythology should open, after an introduction by M. Paul Louis Couchoud, with a chapter on Persia from Achæmenid times down to and including the Mahommedan period by M. Cl. Huart. As the archæological exploration of the Middle East progresses, it looks more and more as if northern Mesopotamia and the Iranian plateau were a key position for some of the major problems of prehistoric and early historic cultural and racial movement. In later times the lands which we now call Persia, and the adjacent regions to the east

* "Asiatic Mythology: a Detailed Description and Explanation of the Mythologies of all the Great Nations of Asia". By J. Hackin, Clément Huart, Raymonde Linossier, H. de Wilman-Grabowska, Charles-Henri Marchal, Henri Maspero, Serge Eliseev. Translated by F. M. Atkinson. Pp. 460. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1932.) 63*s*. net.

under the rule of the monarchs who had been Alexander's generals, and their successors, served as a passage-way to bring the art and culture of the West to the East. Not only did Iranian art penetrate Central Asia about the beginning of our era—this is shown, for example, by a figure which is undoubtedly none other than the Persian hero Rustum in a Buddhist fresco discovered in Khotan by Sir Aurel Stein—but with it appears the art of Greece in both seal impressions and in the wall paintings of "The Cave of the Thousand Buddhas" of Tun-haung on the borders of China.

On the other hand, while there is much in which our knowledge of the religious ideas of early Persia is defective, it is clear that the dualism of the conflict between good and evil characteristic of the cults of Zoroaster, of Mazda and of Manichæus, and the ritual worship of Mithra, the sun god, have played important parts in the development of the religious and philosophical ideas of Greece, of the Roman Empire and of medieval Europe.

While the exploration of the central Asiatic desert by Sir Aurel Stein and the French and German archæologists has revealed a new and entirely unsuspected phase in the artistic development of the East, it is not from what may have been, and in some instances undoubtedly were, the work of western or Eurasian artists, that the effect of the impact of Greek art on the oriental mind can best be gauged. It appears rather in Buddhist art, and more particularly in the art of the school of Gandhara, that Græco-Asiatic kingdom which covered roughly what is now Afghanistan and extended into northern India. Here the Greek ideal impressed itself indelibly on Indian art, and, moving in association with the doctrines of Buddha, extended its influence in the material expression of religious concepts in art-forms so far as the extreme bounds of eastern Asia. In India itself it was the main formative influence which determined the material presentation, in the glyptic art, at least, of divinity once and for all.

It may be that Indian conceptions of divinity at first sight appear fluid and confused. The attributes of the gods and their fields of activity are ill defined, if not at times virtually interchangeable; gods and goddesses appear now in one form, now in another, their names and attributes varying in accord. Their effigies are often difficult to identify. For this the explanation is in part historical: it arises from the fact that Hinduism, essentially one of the most rigid of religious and social systems, has always, paradoxically enough, shown itself ready to assimilate and absorb. This process of assimilation has not ceased. It still goes on; and as jungle tribes come under Hindu influence, their village godlings are gradually assimilated to one or other of the major deities of the Hindu pantheon. Thus these greater deities acquire fresh attributes or even a new manifestation, which may or may not be purely local, according to the importance of the original cult. This process has undoubtedly been in being for many centuries, and to it is to be assigned the number and importance of the attributes of the greater gods.

On the other hand, there is apparent in Indian art and legend the familiar transformation from good to bad, which takes place when different races and beliefs come into conflict. This is evident so far back as Vedic times. The *dēva*, the resplendent ones, of Sanskrit, are the *dīv* or demons of Iran, and to deities of India such as Indra, Sarva, Nāsatyā are specifically attributed demonic functions in the theology of the early Iranians. In Indian mythology the demon *rakshasas* and *nagas* are a memory of the struggles of the invaders with the aboriginal tribes and their tribal gods, the latter, the nagas, the snake gods and goddesses, still regarded as ancestors and worshipped among certain of the hill tribes. It is to be noted, however, that even these appear to have made some progress towards assimilation. The nagas who guard treasure and haunt lakes and pools are sometimes beneficent to man and god.

It is, perhaps, permissible to see something of the age-old urge and power to assimilate, as well as the desire to keep before the worshippers the memory of their aforetime deity, in a characteristic of Indian religious art which is apt to appear bizarre and repellent to the western idea. The multiplication of the upper limbs, with which representations of the deities are endowed, serves to present in one image attributes of the god in a variety of manifestations. In some of the multiple hands are held objects which remind the worshipper of his varied powers. Thus Vishnu holds the discus, the favourite weapon of the gods, the conch or the ladle, while the remaining hands are free for the ritual gesture. In the same way Brahma Trimurti appears with three heads, when it is wished to emphasise his triune character. An artistically 'primitive' materialism enshrines the memory of an ancient syncresis.

This peculiar convention of Indian art naturally is not without its specific significance in relation to the psychology and artistic modes of India. The mind of the artist is more concerned with the expression of the philosophical and theological idea than with the formal realism of the artistic product. His art works through conventions, as does that of any artist; but they are conventions determined by the effort to express religious dogma and not those of sense perception, so far as their essential meaning is concerned. In the two dimensional representation of painting or bas-relief, this intellectual bias is responsible for a lack of observation of the rules of perspective in both space and time. Objects spatially apart are brought into the same plane, consecutive events are represented as though concurrent. In "The Submission of the Elephant" which portrays an episode in the story of the Buddha, for example, the madness of the elephant, the self-sacrifice of the disciple and the submission of the elephant to Buddha are shown within the framework of a single sculpture. This is essentially a 'primitive' character in art.

When the Aryan tribes invaded northern India,

an event which must have taken place somewhere about the middle of the second millennium B.C., they brought with them a group of gods of similar character and function to those of other Aryan-speaking peoples. In fact, the names of certain Indian deities are to be recognised among the gods of the Hittite Empire and the Mitanni. These gods were personified forces of Nature ; and they were departmental gods. Each was concerned with some natural element—Vishnu, Varuna, Agni, ruling over sky, earth, fire and water as Zeus was the sky-god of ancient Greece. They were given no material representation, no effigies of divine personages appearing in India until Buddhist times ; and even in the oldest school of Buddhist art the founder was represented by a symbol. Here the Aryan conquerors did not differ from the aboriginal tribes they conquered. To this day, the village godling, as a rule, has no material image, except at times in the shape of a block of stone. More usually the representation of the divine principle is not that of the godling, but appears in the familiar form of the ubiquitous *yoni-lingam* fertility symbol.

The wide distribution of the fertility cult, of which the *lingam* and *yoni* are the symbol, is of no little interest as an essential feature in much of Hindu ritualism. In the Hindu pantheon, each of the great gods has his divine consort and counterpart ; the essential female principle with Vishnu is Pārvati, and with Siva is Lākshmi. Buddhism had conceded so much to prevalent belief as to retain the gods of the older dispensation as spirits ranking after the saints—of these Brahma and Indra specifically by name—but might be thought to have had little use for the female principle ; yet it was forced, it is said, by popular opinion to admit Hāriti, goddess of smallpox, and significantly enough, of fecundity, to the circle of divine beings represented in the Gandhara sculptures.

The esteem in which are held such great and popular female deities as Kāli and Dūrga and the place they claim in the religious cults of India point to the deep-rooted hold of a fertility cult on the people. It is difficult to avoid the conclusion that this element in Hindu religious belief and ritual must be regarded as a heritage from the cult of the Great Mother Goddess which existed, there is evidence to show, in palæolithic times in western Europe, and extended in later days all along the Mediterranean, through Anatolia, into Mesopotamia. Was it introduced into India by the founders of Mohenjo-daro and those who brought the early civilisation of the Indus Valley ? It is to be noted that all these goddesses, Pārvati, Dūrga the Terrible, Kāli the Black, have their terrifying aspect, which, indeed, is if anything more prominent than any other of their attributes. They bring disease and are the scourges of mankind, delighting in blood and human sacrifice. Such attributes might well have been attributed by the Aryan conquerors to the female deities, with their mystic rites, of the conquered Dravidian tribes, regarding them with terror, even after they had been admitted to their own pantheon.

If it is possible to regard the fertility cult of the female divinity as an infiltration from below, it is also possible that something of the same nature may be held to be one of the causes contributing to bring about one of the most remarkable occurrences in the history of Indian religion, namely, the disappearance from India of Buddhism and the re-establishment of Brahminism. Buddhism endured in India for a thousand years or more ; it inspired some of the greatest religious monuments of the country—great, that is, in the artistic sense ; and thanks in great measure to the missionary zeal of the Emperor Asoka, it spread over a great part of Asia and became one of the great proselytising religions in the history of the world. Yet to-day, except sporadically and in Chinese monasteries, as a living religion it exists only in Ceylon, Further India, Tibet and Japan.

(*To be continued.*)

Petrol from Coal

TECHNICAL hydrogenation is to become an accomplished fact in England. The thorough and patient research in the laboratories of Imperial Chemical Industries, Ltd., which is credibly reported to have involved an expenditure of at least a million pounds sterling, is to be rewarded by being applied to practice, and orders have been given to make a start immediately with a large plant to be erected at Billingham-on-Tees aimed to produce 100,000 tons a year of first-grade petrol. In this plant about 400 tons of coal a day will be put through the process, and another 600 tons a day will be required to make the necessary hydrogen and produce the required temperatures and pressures in the circuit.

The subject has been discussed in our columns previously, particularly in our issues of April 30 and May 7, 1932, and there is little new to add to the technical information then made available. In theory the process is a simple one : it involves the 'cracking' of the coal into relatively simple constituents in presence of an excess of hydrogen, which combines with the unsaturated centres in the molecules, producing saturated hydrocarbons, both straight chain and cyclic, of low molecular weight. The product is akin to natural petrol ; it has a higher anti-knock value.

Though the theory is simple, the practice is difficult. Much depends on the precise conditions at each stage of the reaction ; they have to be studied, recorded and controlled so as to make it always possible to reach the optimum transformation. To this end a large-sized pilot plant has been steadily in operation, always accumulating new

experience which the large plant will help to supplement and enlarge. Apart from the necessary chemical engineering design, there is the problem of handling these very large quantities of materials each day at a regular rate and with maximum economy; this applies in particular to the hydrogen required, which, as the lightest gas, takes up a very large volume. Few processes can have been more carefully thought out in advance than this one of oil hydrogenation, and it is probable that the chemists and engineers of I.C.I. have had the advantage of the advice and criticism of their colleagues in other lands since, as is well known, all the patents in this field are the joint property of an international pool.

A plant of this type has to be visited to be understood for the amazing exhibition of applied science which it represents. On one hand is its enormous size, in keeping with the tonnage which it absorbs; on the other is the multitude of measuring and recording instruments of the greatest complexity and delicacy. A fascinating story could be written of these, each type illustrating an advance in theoretical knowledge, each leading to progress in practice. To the casual visitor, the plant will be perhaps just an up-to-date Colossus eating coal, excreting petrol—a money maker; but the scientific worker will be able to trace much of the progress of science pure and applied in it from the discovery of hydrogen, the understanding of the double bond, Sabatier's conception of catalytic hydrogenation, the early attempts of Bergius to make oil from coal, down to the team work of the I.C.I. staff which has made it possible.

It is as an economic experiment that the venture invites criticism. When petrol can be delivered at British ports at about 3½*d*. per gallon, why make it from coal at a minimum cost of 7*d*.? The process can only succeed financially in England when it is protected by a duty such as the Government has pledged itself to retain for nine years. Such action will involve a loss in customs receipts amounting to £1,000,000 per annum. But in these days of depression, there is another side to the venture—that of the employment at home to which so large a plant will give rise. The construction of the plant is estimated to take eighteen months and it will produce much activity in the iron and steel industry—during this period some 12,000 men will be employed; ultimately permanent direct employment will be given to 2,500 miners and process workers, as well as much indirect employment. There can be little doubt that much more than the million will be returned to the State both in the form of saved unemployment pay and of receipts from taxation. The mines and the railways will share in the new work, whilst last, but by no means least, is the psychological effect of the new activity in a heavily depressed area.

On balance, therefore, the scales are heavily weighted in favour of such action as the Government has encouraged I.C.I. to take, and though to the purist it is akin to madness to make a product at twice what it can be purchased for elsewhere, such is the effect of the intense nationalism from which the world is suffering. It may be urged also that it is illogical to take as the comparative price of petrol a figure which results from overproduction and excessive competition in a world market with falling consumption: a few years hence may see a very different price for this commodity.

The Billingham plant will be adapted to hydrogenate both coal and the oil from coal produced either by low- or high-temperature carbonisation. It is to be hoped that I.C.I. will see their way to pay a liberal price for such low-temperature oil, so as to encourage its production with the consequent repercussion on the sorely tried coal industry. There is something to be made also out of the creosote oil of the tar distiller by hydrogenation, though its treatment and utilisation bring new problems with them. What is wanted is a plant situated centrally for the larger groups of tar distillers, operated perhaps on a co-operative system in partnership with I.C.I. The products of coal are not fetching a proper price in relation to their real value to-day; they are being degraded rather than ennobled, and though we would prefer to see them converted into dyes and drugs and chemicals than burnt in the automobile, the fact is that at the moment the latter is the larger and more profitable outlet. The problem of the hydrogenation of the tar oils is a serious one and it should be put next on the list for action; it should at least be enjoined that no selfish holding up of the patent rights should entail delay.

The actual pledge of the Government made by the Prime Minister on July 18 is equivalent to a preference of 4*d*. per gallon for nine years from April 1, 1935, and it has been repeated in these words to the benzol-producing industry by the Secretary for Mines, Mr. Ernest Brown, M.P.

The necessary new capital for the scheme, estimated at about 2½ millions sterling, will be provided by I.C.I. from their existing resources. It is understood that the marketing of the new petrol will be in the hands of one of the old-established oil companies.

Quite apart from the aspects that have been considered, the new development has significance as a serious attempt to make some use of our coal resources other than by burning the raw coal. Low-temperature carbonisation has so far failed to make real headway, for reasons which cannot be discussed here, but the pioneer efforts of the South Metropolitan Gas Co. are showing that in the hands of competent engineers and chemists this process also has its prospects. Coal is convertible into gas, coke and oils. Good use can be made of the first two, particularly since coke, like gas, has been sold of standard and constant quality. It remains to make more of the oil. This accomplished, coal may once more take its place among the mineral treasures of Great Britain instead of being a source of social anxiety.

News and Views

Economy Cuts in Scientific Research in the United States

DRASTIC cuts are being effected, in the name of economy, in the staff of the Bureau of Standards Laboratories, Washington. According to information circulated by Science Service, 380 members of a staff of 974 are being dismissed, and the reductions involve the closing of the only public research laboratory in the United States devoted to the study of photographic films, leaving the Government dependent on the few commercial film companies for knowledge of the emulsions and films required by its military or civil departments. Research work and the information service on metallurgy are also being closed and the Government testing of aeroplane engines is being discontinued, reliance for all this work affecting the safety of fliers and the flying public being placed on the manufacturers instead of on a Government certificate. Similarly, the Altitude Laboratory of the Bureau, the only one in the world publishing research for the benefit of the public, will be idle; it is stated that no aeroplane manufacturer has the same facilities for determining the behaviour of a motor or a fuel or lubricant at very high altitudes. The total savings estimated as being achieved by the reductions amount to 650,000 dollars, but they will undoubtedly be offset by losses incurred by the public, industry and Government departments amounting to many times this sum, due directly to the absence of testing facilities, expert advice and control, apart altogether from the considerations of safety to life and health. The scrapping of laboratories of this type, which have taken a decade to build up and are scarcely duplicated anywhere, is deplorable. It is clear that the Government of the United States fails to appreciate the productive services of scientific institutions.

National Research Council of the United States

THE report of the National Research Council for the year July 1, 1931–June 30, 1932, provides an interesting commentary bearing on the note above. It covers the sixteenth year of the Council's activities and includes an account of the founding and organisation of the Council. It is an organisation devoted primarily to the promotion and co-ordination of scientific research rather than to the actual conduct of investigations. Its operating divisions include specific fields of science such as the physical sciences, engineering, chemistry, geology and geography, the medical sciences, biology and agriculture, while other divisions are concerned with research information service, and with general relations of the Council with the Federal Government, scientific agencies of the State governments, and educational institutions. The Council is the official representative in the United States of the International Council of Scientific Unions. With the financial assistance of the Rockefeller Foundation, the National Research Council administers three series of research fellowships for men and women who have comparatively recently received their doctor's degree or equivalent qualification, the fellowships being granted for research under competent specialists in university laboratories or in other research institutions. Some 774 fellows have been appointed and of 152 active fellows in March 1932, 63 were working in physics, chemistry or mathematics, 27 in medical sciences, and 62 in the biological sciences, all but 25 of these fellows studying in the United States. The term of the fellowship is on an average a little over a year and a half and the average age of appointment, 27–28 years. In addition to the fellowships, the Council encourages research by grants in aid of individual investigations and for certain types of co-operative research and for conferences. It has also assisted in financing the publication of the "Index to the International Critical Tables" and of the "Annual Tables of Constants and Numerical Data in Chemistry, Physics, Biology and Technology".

Science in the Petroleum Industry

ON July 21, Sir John Cadman gave a lecture at the Royal Institution to members of the World Petroleum Congress on "Science in the Petroleum Industry". This was perhaps the most appropriate place which could have been chosen, for it was in the lecture theatre of that building that Faraday exhibited the first substance which could be truly called a petroleum product, and in those laboratories that he produced the first synthetic petroleum a hundred years ago. Science has played an important part in the economic development of oil fields and in the production of crude petroleum. Co-operation between geologists and physicists has brought the elimination of abortive drilling within the bounds of possibility. Field operatives, if they would utilise fully the scientific data at their disposal, could minimise waste of time, labour and money involved in unproductive drilling. Rapid advances have also been made in the industry as a result of pure research. Helium gas is now produced as a commercial commodity and used extensively in airships, where its stability and incombustibility are essentially desirable. Carbon black is utilised to a great extent in the automobile and other industries as a reinforcement of rubber. It is now possible to produce an emulsion of oil and water which is admirably suited for road-surfacing purposes.

SPEAKING particularly of the motor car engine, Sir John Cadman referred to the discovery that bottled gas, consisting of propane and butane and derived from natural gas, can be utilised as a fuel, and it is therefore conceivable that cylinders of this product could in the future replace petrol to a large extent. In the meantime, though much has been achieved towards the production of an anti-knock fuel, continued research is still necessary, since the motor industry is constantly increasing the pressure of engines and looks to the petroleum industry to supply a spirit which will not 'pink' under these exacting conditions. On the question of over-production of

fuel-oil, so strongly emphasised by Mr. Kessler in his lecture at the Congress on "Rationalisation of the Oil Industry", Sir John Cadman stated that the Anglo Persian Oil Co., Ltd. has adopted the practice of restoring excess oil to the reservoir, where it is renovated by its absorption of light volatile oils and can be stored there until a legitimate demand for it occurs, thus conserving the limited reserves of crude petroleum.

Oil Industries Exhibition

CONCURRENTLY with the World Petroleum Congress, the "Oil Industries Exhibition" was held at the Royal Agricultural Hall, Islington. The major exhibits included a scale model of an airport at King's Cross for which Central Airports, Ltd. are seeking Parliamentary sanction; a Fiat seaplane engine which holds the world's record for speed and develops 2,900 horse-power; and models illustrating the facilities which exist at the Port of London and in the docks alongside the Manchester Ship Canal for the importation and distribution of petroleum and heavy oils. In addition, there were models of Southampton docks, the White Star liner *Homeric*, the L.M.S. engine *Royal Scot*, the Gladstone docks at Liverpool and a panoramic view of Liverpool docks. Manufacturers of instruments and equipment for the production, testing and refining of petroleum and petroleum products also supplied many interesting exhibits. Unfortunately, it cannot be claimed that the exhibition was a success either from the point of view of numbers and variety of exhibits or of attendance. Many leading firms in the industry had no representation whatever, and one looked in vain for that fullness of demonstration and display, both technical and commercial, which an oil industries exhibition should, and usually does, connote. Coinciding as it did with the World Petroleum Congress, it was a poor advertisement for the commercial activities of the industry which, on this occasion at least, should never have been permitted. A drastic revision of all the circumstances of this exhibition, particularly as regards habitat, is imperative in the best interests of the industry and certainly as a safeguard to prevent a recurrence of failure in the future.

Science and Industrial Change

IN an address delivered on July 19 at the centenary celebrations of the Royal Cornwall Polytechnic Society, Sir John Cadman referred to the immense economic and industrial changes which have been witnessed in the last hundred years, and in which the geologist, the chemist, the biologist, the sociologist as well as the engineer have played their part. Between the crude and imperfect engines and machines of the early nineteenth century, which were still largely or in part hand-made, and the tempo of modern industrial life as represented by the Schneider trophy engine, the pistons of which move up and down their cylinders 3,000 times a minute, or the turbine running at anything up to 10,000 revolutions in the same time, there is an almost incredible gap. Sometimes improved methods of steam-raising have been the main factor in progress, at others a new mechanical invention, at others again some external economic situation. The relative importance of different factors or changes is hard to assess. The average life of the citizen has been prolonged by possibly a couple of decades, the standard of life has been raised and science has multiplied the products of the world, in kind as well as in quantity. He has more leisure and more facilities for entertainment as well as more opportunities for acquiring knowledge. The importance of polytechnic societies has, if anything, been increased. They provide a remedy which counteracts the great tendency towards routine in modern life, and by assisting the broadening and stimulating of his mind, they enable the citizen to discharge the wider responsibilities which devolve upon him in the modern world. After referring to the value of polytechnic societies as focal points of education and in encouraging travel, Sir John Cadman displayed a film illustrating the development of the Persian oil industry.

Meteorology and the Amateur

SIR NAPIER SHAW delivered a lecture on "Unofficial Meteorology" at Falmouth on July 20 in connexion with the centenary celebrations of the Royal Cornwall Polytechnic Society. The subject chosen was a very suitable one, because certain branches of meteorological study—weather forecasting with the aid of synoptic weather charts, for example—are more easily pursued at a central office by professional meteorologists than by isolated amateurs, and Sir Napier could not have encouraged amateurs in that rather remote corner of England more effectively than by indicating some of the lines of research along which the advantages of a central office are offset by the quiet and leisure available to an amateur in rural surroundings. He had a good deal to say about work with the camera, especially one of the cinematograph type which could be made to reveal, with a suitable time-scale, the details of cloud development, the deciphering of which would make large demands on the patience of the observer when watched in the ordinary way, and which are moreover not necessarily appreciated without some such device. The success of the cinematograph in showing plant growth gives an encouraging analogy. Sir Napier also discussed the diagrammatic display of local weather records such as may be kept by an amateur, and the study of plant growth in relation to weather, when the latter is integrated over a period of suitable length. Slides of a number of Mr. C. J. P. Cave's excellent cloud photographs were exhibited as examples of the best amateur work in that branch of photography.

British Policy as regards Air Records

THE Marquess of Londonderry, secretary of State for Air, replying to a question by Lord Gorell in the House of Lords on July 19, laid down the policy of the Government upon the question of the use of R.A.F. equipment and personnel for attempts upon world aeronautical records. He estimated that for

an attempt to regain the speed record recently captured by Italy, at least £200,000 for aircraft, engines, and accessories would be required. In addition, the danger to life and limb is a factor which cannot be ignored; already four British and four Italian pilots' deaths have been due directly to such attempts. The Government, he said, has decided that the R.A.F. is not to be diverted from its normal duties to make attempts upon world records when there is no genuine purpose to be served thereby. In the present stage of development, this principle rules out any immediate attempt on the speed record. If in the normal course of technical development, it appears that we can achieve still better results than those already obtained, whether in speed, height, or long distance, without an undue diversion of service personnel from their proper function and without subjecting them to other than normal service risks, then the making of an attempt to set up a fresh record might well be justified. While there is no doubt that the achievement of such records redounds to the prestige of the R.A.F., and the standing of the aircraft industry, it is possible to exaggerate this value. An aircraft that excels in any one particular sphere will probably always hold the market amongst purchasers requiring those qualities, whether or not the country of its origin happens to hold aeronautical records at the moment. Valuable lessons have been learnt during previous attempts, but it is doubtful whether a further attempt at the present time would produce technical information of comparable value.

Flight Round the World

MR. WILEY POST landed at the Floyd Bennett flying ground just before midnight on July 22, having completed a solo flight round the world in 7 days 19 hours. According to the New York correspondent of the *Times*, he had flown 15,596 miles with only ten stops at an average speed of nearly 130 miles an hour. Mr. Post's first 'hop' was from New York to Berlin, a distance of about 4,000 miles, which was covered in 25 hr. 45 min., thereby creating records for distance solo flight and time. He was forced by bad weather to land later in the day at Königsberg, in East Prussia. His next point of call was Moscow, where he stayed three hours. From there he flew to Novosibirsk and on to Irkutsk. The next stage was from Irkutsk to Harbarovsk, broken by an enforced landing on account of bad weather at Rukhlovo. From Harbarovsk Mr. Post flew over to Alaska, landing at Flat, where he damaged a propeller. The next point was Fairbanks, and from there on to Edmonton and New York, Mr. Post had favourable conditions. It will be recalled that Mr. Wiley Post accompanied Mr. Harold Gatty in a flight round the world in 1931. In his recent flight he used the same aeroplane, the *Minnie Mae*.

Puma at the London Zoo

THOUGH the addition, a few days ago, of a young female puma to the Gardens of the Zoological Society of London introduces no novelty, we venture to direct the attention of ecologists to its arrival; for here is an animal with some very noteworthy aspects in its life history. The largest of the North, and the second largest of the South American Felidæ, attaining a length of 7–8 ft., it displays a singular versatility in its powers of adjustment to environments standing in the strongest possible contrast. This much might be inferred from the fact that it ranges from Alaska to the extreme south of Patagonia, in this regard out-distancing any other mammal. In North America it feeds on deer, whenever they are to be had, and failing these, on such small animals as mice, and even snails. In South America it ascends the Cordilleras of Chile to a height of 10,000 ft. and in the Peruvian highlands similarly it is to be met with up to the snow-line. Here the guanacos are its prey. In the primeval forests of the Amazons it has taken to the trees, and bounds from bough to bough in prodigious leaps after monkeys: though it also hunts the tapir and other ground game. In the pampas it finds the rhea an easy prey. Unfortunately, it will attack both horses and sheep, and hence has excited no small animosity on that account. Naturally, in so wide a range, the typical tawny coloration, relieved only by an indistinct dorsal stripe, shows more or less marked colour-variations, but these are not sufficiently great to justify specific distinctions. The young, it is to be noted, are spotted, but their spots disappear in about six months, though traces may be found in much older animals. The name 'mountain-lion' has been bestowed on it on account of a superficial likeness to the lion; but the puma has much shorter legs, a much longer tail and no mane.

Measures Against the Musk-Rat

IN the House of Lords on July 12 an interesting statement was made by Earl de la Warr concerning the measures which have been taken against musk-rats in Britain. He pointed out, in reply to a series of questions by the Earl of Ilchester, that in the 700 square miles of Shropshire where trapping operations have been carried on, 2,053 musk-rats have been killed; in Sussex 125 have been captured, in Surrey 21. The greatest number caught in a week in Shropshire was 117 (week ending March 25, 1933) and since then the numbers have fallen so that with 28 trappers at work the weekly average has decreased to 12. The Ministry of Agriculture is satisfied that the menace generally has been much reduced, and that there is now no necessity to introduce new machinery to deal with the matter. In Scotland the evidence points to the presence of musk-rats in considerable numbers only in the counties of Perthshire and Stirlingshire. The cost of the campaign during the last financial year was £2,873 in England and about £1,340 in Scotland, while the estimates for the current year were respectively £5,500 and £2,600. A short time ago the Irish Free State Department of Agriculture announced that a musk-rat had been shot near the mouth of the Nenagh River. About four years ago a pair were imported into Ireland, but in the course of a few weeks escaped from confinement; the recent

specimen is presumably one of their progeny, if not one of the originals. The Department stated that a campaign against the pest is to be undertaken.

Recent Acquisitions at the British Museum (Natural History)

THE Trustees have purchased for the Department of Zoology an exceptionally fine African elephant tusk, weighing about 214 lb. This tusk is one of a pair which belonged to a very old elephant killed by an Arab in the Kilimanjaro district many years ago. The other tusk was purchased for the Museum in 1901. The pair are thus now together again. These are the heaviest tusks known. A collection made by Mr. F. Shaw Mayer consisting of 170 mammals from New Guinea, also acquired by purchase, contains many rare specimens and probably some new forms. The most conspicuous animal included is a tree-kangaroo of the genus *Dendrolagus* (probably *Dendrolagus burgersi*). This animal is bright chestnut-red in colour with light yellow markings. Mr. R. E. Moreau, the secretary and librarian of the East African Agricultural Research Station at Amani, which is situated at an elevation of about 5,000 ft. in the Usambara Mountains, Tanganyika Territory, has made for the Museum during the past five years a valuable collection of birds consisting of some 813 skins. Their value is further enhanced by their being accompanied by many field notes and observations on the nesting and other habits of the birds. A valuable collection of Thysanoptera, or thrips, comprising more than 43,000 specimens, has recently been acquired for the Department of Entomology from Dr. Oscar John. This makes the national collection of Thysanoptera one of the most comprehensive in existence. Further specimens of transparent pale yellowish silica glass, the largest piece weighing 2,279 gm., from the Libyan Desert, has been presented to the Department of Minerals by the Director of the Survey of Egypt.

AMONG the recent acquisitions of the Department of Botany are two British herbaria. The first is that of Philip Sewell (1865–1928) presented by Mrs. H. G. Sewell. It contains about 3,000 sheets and is a useful addition to the collections as it contains many plants from the Cleveland division of Yorkshire, an area not well represented previously. Sewell worked with James Backhouse in his nursery at York and later was naturalist with Capt. Wiggins in the *Labrador* which went to Siberia to explore, among other things, the possibility of the Trans-Siberian Railway. The second is the herbarium of Dr. Edward Ballard, presented by his grandson, Mr. N. A. Mackintosh, of the *Discovery*. The herbarium contains about 700 sheets. Ballard was medical officer of health at Islington and gained eminence in many branches of sanitation. It is known that his manuscript "Catalogue of Islington Plants" is at the Stoke Newington Public Library (*J. Bot.*, 66, 1928). The plants mentioned are in the herbarium and are of interest as, even in 1842, "for obvious reasons some of them are no longer to be found in the situations here assigned them".

Cambridge Visit of Physical Society

THE Physical Society paid a visit to Cambridge on Saturday, July 22, and in the morning the works of the Cambridge Instrument Co., Ltd., were visited. The processes involved in the manufacture of various types of instruments were demonstrated and in the Research Department of the works a very interesting display of new instruments was shown in the development stage. Mr. R. S. Whipple, speaking at the luncheon given to the two hundred members of the Society and their friends by the Company, stated that this was the third visit of the Society to Cambridge; the first being in 1914 under the presidency of Sir J. J. Thomson and the second in 1924 when Sir Frank Smith was president. Prof. A. O. Rankine replied on behalf of the Society; he said that gratifying responses have been received to the proposal that the Society should publish annual reports on the progress of physics; substantial donations towards the cost have been received from Prof. W. N. Stocker of Brasenose, Sir J. J. Thomson, and Mr. R. W. Paul. In the afternoon, a meeting was held in the Cavendish Laboratory; Lord Rutherford gave an introductory address, which was followed by papers on recent work on atomic disintegration by Dr. Walton, Mr. Dee, Dr. Oliphant and Mr. Lewis.

The University in National Life

AUCKLAND UNIVERSITY COLLEGE, New Zealand, celebrated the fiftieth anniversary of its foundation by a reception held on May 22 at which the Governor-General, Lord Bledisloe, spoke on the place of a university in the life of a nation. The speech, an eloquent restatement, adapted to present-day conditions, of time-honoured university ideals, emphasised the peculiarly grave responsibilities of a university in an island country remote from the world's great centres of population, wherein all the young people are necessarily preoccupied with earning a livelihood or with 'bread-and-butter studies', especially in times when national prosperity is conditioned by international co-operation and mutual knowledge. To its university colleges New Zealand must needs look for a wholesome and informed recognition of what is best in art, for keeping abreast of current developments in the natural sciences, for courageous and knowledgeable leadership in public life and in every branch of professional, industrial and commercial activities and—an essential condition of success in a world of severe and increasing competition among nations, especially those of Nordic race—the raising in every faculty and sphere of training and investigation, of the standard of thoroughness and accuracy and the self-discipline and perseverance that go with them. If they are to fulfil this high mission, the colleges must beware of truckling to the lack of knowledge or the weaknesses of the proletariat, and in the name of democracy levelling down educational and vocational standards, thus putting a premium on intellectual mediocrity, curbing opportunities of self-realisation, and stifling the genius of the nation.

African Administration and Native Institutions

IN the *Journal of the African Society* for July, questions arising out of native administration and native conditions and institutions generally receive attention in several communications. Dr. Arthur E. Horn concludes a series of three articles on the control of disease in tropical Africa, and Major Orde Browne contributes the second and concluding part of "British Justice and the African", in which the establishment of the law in the eyes of the native as worthy of the respect formerly paid to tribal custom is stressed as the outstanding need. Those who are especially interested in the place of native institutions in the administrative system will find much material for consideration in "Native Administration in West Africa" by Mr. E. J. Arnett, in which the author institutes a comparison of French and British policy and methods, basing his argument on the four memoranda issued by M. Brevié, Governor-General of French West Africa, to the lieutenant-governors of the group of colonies under his command. In these memoranda, M. Brevié reviewed the principles of policy in the past and in describing the new methods which the memoranda promulgate, demonstrates their relation to previous methods, not as reforms, but as links in the chain of civilisation. Mr. Arnett shows that while 'association', taking the place of 'citizenship' in the new application of policy, gives further recognition to the character and place of native institutions in the development of native life, it contrasts with the analogous system of indirect rule under British administration by using native institutions as an instrument only of the governor, and does not admit the power, initiative and independence left to the native, under supervision, in the British colony.

World Power Conference

THE concluding meetings of the World Power Conference in July were held in Norway at Oslo and Trollhattan. They were held in conjunction with the first congress on large dams. Mr. Kloumann, director of the Norwegian Aluminium Company, welcomed the delegates to Norway. In his address he stated that the potential water power in the world is equal to 2,220 million tons of coal every year. Only 7½ per cent of this water power is utilised. He estimated also that coal and oil power would be exhausted in between 200 and 300 years. He quoted the American forestry authorities as saying that, if America continues to use timber at the present rate, the supply will be exhausted within the lifetime of the present generation. He calculated that the cost per annum of one hydro-electric horse power in his own plant varied between 3*s*. 9*d*. and 5*s*. 6*d*. He suggested a future super power system interconnecting all water power stations in France, Germany, Italy, Scandinavia and Switzerland and supplying all Europe. Mr. Svanoe stated that the majority of local power stations for the large industries of Norway are so far apart that, up to the present, interconnexion by transmission lines does not seem commercially feasible. The bulk of the power plant in Norway is used for electro-chemical industry and metallurgy. The capital value of the power plant used by these manufacturing works exceeds 12 million pounds, and the cost of the energy supplied is 0·053*d*. per kilowatt hour. The power required for treating and manufacturing wood pulp, cellulose and paper is only about a quarter as much, but for mining, textiles, etc., it is about two-thirds as much. It appears that last year the electric supply of Norway was run at a loss.

Luxury Coaches for Road Transport

IN the *English Electric Journal* for May 1933, a description is given of the new luxury coaches which the English Electric Co. is manufacturing for road transport organisations. The coaches are admirably adapted for long distance service; comfort rather than ostentatious luxury has been the aim of the designers. The body has a sliding roof controlled and operated by the driver. Light luggage is carried on spacious racks placed above the side windows. Heavy luggage is stowed in roomy compartments below the floor of the saloon to which access is obtained from the back and near side of the coach. There is accommodation for 28 passengers. Two comfortable seats are placed on each side of the central gangway, and are so arranged that the passengers have an unrestricted view of the passing scenes. Toilet apartments are provided at the back of the coach. Illuminated destination indicators are fitted on the roof over the driver's cab. Eighteen of these coaches have been ordered from the English Electric Co. by the Ribble Motor Services, Ltd. One of them has been running between London, Birmingham and Blackpool for some time and has proved very popular. It seems that further co-operation between the railway companies and the road transport organisations in Great Britain is desirable.

Antiquities from Tell Duweir

THE exhibition of antiquities from Tell Duweir (Lachish) at the rooms of the Palestine Exploration Fund, 2 Hinde St., W., in selection and arrangement give an instructive view of the importance and varied interest of the site. In this connexion the section through 36 ft. down to bedrock from the north-east corner of the Tell, which shows the archæological history of the site from about 3000 B.C. until 1200 B.C., is especially helpful; while Mr. McWilliams' reconstructions, imaginative it is true, suggest, not without justification, that at the height of its prosperity the city was indeed imposing. The sequence of pottery, of which it will be remembered from the report on the excavation (see NATURE of June 24, p. 897) a complete series was obtained, is well shown and interesting vases of the Hyksos period, including some highly decorative pieces, afford an opportunity for comparison with material obtained by Sir Flinders Petrie at Tell Ajjul. The later members of the sequence, when subjected to further study, will, it may be anticipated, throw much light on the cultural relations of Duweir,

especially with north and east, in the earlier 'palace' period of occupation. A large number of smaller objects, scarabs, bronze rings, pottery, rattles and figurines, together with stone and alabaster vases, some dated at the xviiith dynasty, from the tombs are shown. Interesting miniature furniture of the period of the Jewish kingdom, it has been suggested, may have had a magical intention. Next to the bronze helmet crest-piece (NATURE, loc cit., Fig. 2, p. 898), the most interesting exhibits are a 'Maat' feather of gold leaf on textile fabric and plaster, dated at about 1300–1200 B.C., which was found in the suburban settlement on the side of the Tell, and a piece of fluted iron mail which concurs with the crest piece in recalling the Lachish reliefs in the British Museum.

Imperial Institute

THE annual report for 1932 of the Imperial Institute has recently been published by the director, Lieut.-Gen. Sir William Furse (Pp. 54. London: Imperial Institute, 1933. 2*s*.). The work of all the departments continues to expand. The exhibits have been improved and amplified and attract increasing attention from schools and other institutions. This, however, is only one aspect of the work of the Institute. The Investigation Section has been active in the examination of various raw materials such as fibres, woods, oils, etc. and the assessment of their value. Other inquiries have dealt with insecticides, suitable crops for particular conditions, and the marketing possibilities of such varied products as beeswax, duck feathers and dried fruits. Investigations on minerals from many parts of the Empire have been numerous and the useful "Statistical Summary" of the world's chief minerals was issued as usual. Various countries continue to devote attention to such matters as Empire timbers, silks, fibres, oils and resins, hides and skins and tanning materials.

Rotenone as an Insecticide

ACCORDING to Science Service, Washington, D.C. (June 10) the compound rotenone is the latest addition to chemical methods of controlling insect pests of crops, animals and the household. It was first discovered through the use of plants containing it as fish poisons by natives of tropical countries. Its principal commercial source is the derris plant of the East Indies, but it is also present in a South American plant called 'cubé' and in the North American plant popularly termed 'devil's shoestring'. All the plants that are known to yield rotenone are members of the natural order Leguminosæ. Rotenone is exceedingly toxic to many kinds of insects but quite harmless to man and all warm-blooded vertebrates. While not all insects are susceptible to its toxic effects, in the form of sprays and other preparations, it has been shown to be fifteen times as toxic as a nicotine spray when used as a contact poison against aphides, and thirty times as toxic as acid lead arsenate, when tested as an internal poison against certain caterpillars.

Announcements

PROF. EDWARD MELLANBY has been appointed secretary of the Medical Research Council in succession to the late Sir Walter Morley Fletcher. Prof. Mellanby, who has been professor of pharmacology in the University of Sheffield since 1920, is at present a member of the Council. He will not assume full duty as secretary until next January. The secretary of the Medical Research Council is *ex officio* secretary of the Committee of Privy Council for Medical Research.

MR. W. A. ROBERTSON, of the Indian Forest Service (retired), has been appointed Director of Forest Products Research under the Department of Scientific and Industrial Research in succession to Sir Ralph S. Pearson who retires on September 30.

DR. STANLEY H. BADOCK, pro-chancellor and treasurer of the University of Bristol, has accepted the office of president of the next Congress of the Royal Sanitary Institute, which is to be held at Bristol on July 9–14, 1934.

THE Institution Engineering Gold Medal of the North-East Coast Institution of Engineers and Shipbuilders has been awarded to Mr. W. T. Bottomley, for a paper entitled, "Radiation in Boiler Furnaces", read before the Institution on January 13.

THE tenth annual conference of the Association of Special Libraries and Information Bureaux will be held in the Wills Hall, Stoke Bishop, Bristol, on September 22–25, under the presidency of Sir Charles Sherrington. During the conference a symposium will be held on the "Planning and Editing of Information Bulletins and House Journals". Further information concerning the Conference, which is open to non-members, can be obtained from the Secretary, 16, Russell Square, London, W.C.1.

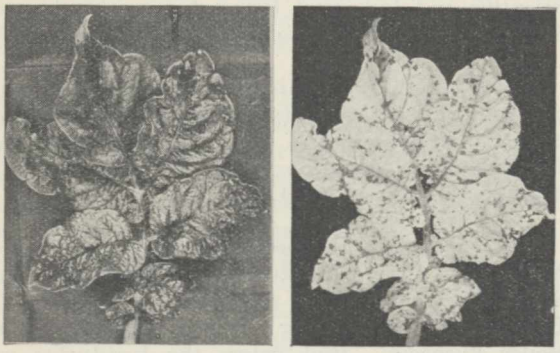
APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in physiology at the University of Leeds—The Registrar (Aug. 5). A lecturer in physics at the University of Reading—The Registrar (Aug. 5). An assistant lecturer in applied mathematics at the University of Liverpool—The Registrar (Aug. 14). An assistant lecturer and demonstrator in chemistry at Robert Gordon's Technical College, Aberdeen—The Registrar (Aug. 14). Two geologists in the Geological Survey of Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2 (Aug. 15). An assistant civil engineer to the Assam-Bengal Railway Co.—Messrs. Rendel, Palmer and Tritton, 55, Broadway, Westminster, S.W.1 (Aug. 15). An assistant librarian at the Polytechnic, 309, Regent Street, London, W.1—The Director of Education (Aug. 19). A teacher of geography at the Borough Polytechnic, Borough Road, London, S.E.1—The Principal (Sept. 7).

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.*]

Infra-Red Photography and Plant Virus Diseases

IN working with the 'streak' diseases of the potato, great difficulty has been experienced in obtaining adequate photographs of the necroses occurring in the dark green leaf, by means of panchromatic plates and reflected light. Necrotic leaves, unless the necrosis is extensive, photographed by this method

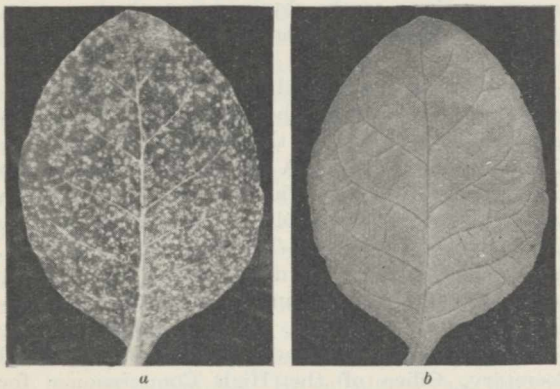


a *b*

FIG. 1. A necrotic potato leaf photographed (*a*) on a panchromatic plate, and (*b*) on an infra-red plate.

usually give pictures of healthy looking leaves (Fig. 1*a*).

By the use of the new infra-red plates, however, it has now been found possible to obtain photographs giving perfect contrast between the leaf and necroses. The normal leaf cells reflect infra-red rays almost completely and in the positive are white, whilst the necrotic areas are jet black (Fig. 1*b*). All necroses



a *b*

FIG. 2. A tobacco leaf infected with a virulent strain of the 'X' virus photographed (*a*) on a panchromatic plate and (*b*) on an infra-red plate.

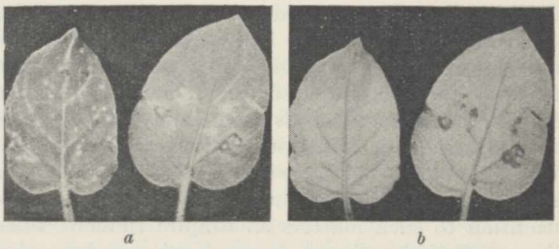
produced in the potato, regardless of the causative virus, behave in the same manner.

In photographing the necroses produced in tobacco by the 'X' virus, completely opposite results are obtained. The colour contrast between the leaf and necroses is great and they photograph well on panchromatic plates (Fig. 2*a*). In contrast, photographs of such necrotic leaves taken on infra-red plates present an appearance indistinguishable from that of healthy leaves (Fig. 2*b*). All mottles also react similarly and photograph well on panchromatic plates, but they disappear entirely in infra-red pictures.

These results may be explained by the different chemical structure of the necroses and by the fact that the panchromatic plates distinguish only between colour changes, whilst the infra-red plates are insensitive to these as such and distinguish between chemical changes which affect the reflection of infra-red rays. The potato necroses consist of dead cells which contain large amounts of breakdown products, rich in pectic substances and possibly tannins, and these completely absorb infra-red rays. On the other hand, the 'X' type tobacco necroses consist merely of dead empty cells, that is of cell walls only, which reflect infra-red rays in the same degree as normal cells.

Support for this view is obtained from the photographs of *Nicotiana glutinosa* infected with the 'X' virus and tobacco suffering from tobacco ringspot. The colour contrast between the leaf and necroses in these is fair and all the necroses show in panchromatic photographs (Fig. 3*a*). With infra-red photographs a proportion only of the necroses appear, but these show up more definitely (Fig. 3*b*). On examination, these are found to contain degeneration products, whilst the remainder of the necroses consist merely of dead empty cells.

The infra-red plates are so sensitive to necrotic changes in the potato that clear photographs can be



a *b*

FIG. 3. Leaves of *Nicotiana glutinosa* infected with a virulent strain of the 'X' virus photographed (*a*) on a panchromatic plate and (*b*) on an infra-red plate.

obtained of commencing necrosis barely visible to the eye, and it seems possible that in addition to the limited use of recording disease symptoms, infra-red photography may have a much wider application in the detection and differentiation of certain chemical changes actually occurring in the living plant.

F. C. BAWDEN.

Potato Virus Research Station,
School of Agriculture,
Cambridge.
July 1.

The Crystal Photoeffect

SEVERAL explanations have been proposed for the electromotive force produced in crystals of cuprous oxide by illumination, such as the light pressure hypothesis of Dember[1], the diffusion theory developed by Teichmann[2]; recently Deaglio[3] has suggested an electrolytic origin. We have shown[4] that the diffusion theory in its original form is insufficient to account for the potential distribution in an illuminated crystal. The theory shows clearly that the area struck by a light beam will have the highest positive potential. It does not seem equally clear that the

spot just opposite will have the lowest negative potential, lower even than a dark section of the same crystal. It seems, however, that a good agreement with experimental facts can be reached, assuming that the equilibrium of electrons in an illuminated crystal is dynamic and consists of a continuous circulation of electrons between the bright and the dark parts of the crystal.

FIG. 1.

It would be erroneous to assume a proportionality between the bright energy absorbed in some part of the crystal and the electron concentration there. It is, however, correct to replace the ratio of concentrations n_1/n_2 in two small volumes by the ratio σ_1/σ_2 of conductivities. It is then possible to test experimentally the fundamental equation of the diffusion-theory of the photoelectromotive force, P:

$$P=\frac{kT}{\varepsilon}\log\frac{n_1}{n_2}=\frac{kT}{\varepsilon}\log\frac{\sigma_1}{\sigma_2} \quad \ldots \quad (1)$$

We used a long crystal provided with four transparent gold electrodes (Fig. 1). Measuring the ratio of conductivities at both ends of the crystal, we got for σ_1 too low, and for σ_2 too high a value because of the finite thickness of the sheet measured. Taking into account this systematic error we found a satisfactory agreement between the computed and measured values of P.

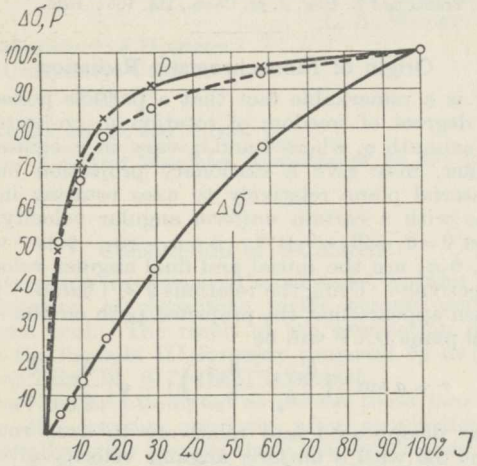


FIG. 2.

The best proof for the formula (1) is the dependence of P on the light intensity I. Using a Zeiss filter, we were able to reduce the light intensity to 4, 7, 10, 15, 30, 60, and 90 per cent of its initial value. Fig. 2 shows the corresponding values of $\Delta\sigma_1$ (photoconductivity) of observed P (full line) and of computed P (dotted line). The small discrepancy is accounted for by the systematic error in σ_1/σ_2.

It is well known, and regarded as an anomaly[5], that photoconductivity is always restricted to the red end of the absorption band and vanishes within the region of high absorption. From curves such as Fig. 2 we computed the conductivity in a layer adjacent to the electrode and found a marked photoconductivity in the whole absorption band at liquid air temperature.

The second conclusion which we have drawn from our experiments is that the electron equilibrium in an illuminated and isolated crystal is dynamic in character. There are always two streams of electrons corresponding to two opposite and equal currents. The carriers of the photocurrent are different from the heat electrons. They are either electrons of higher energy levels or a few empty levels in a fully occupied band, acting as positive electrons. It seems to be the only possible explanation for the actual potential distribution in a crystal. The recent experiments of Deaglio, though unconvincing for the electrolytic nature of photoconductivity, show clearly a distinction between the two kinds of conductivity. Moreover, the change in the absorption curve in the excited state of an illuminated crystal gives supplementary support to the view that light produces a different kind of electric carrier from that produced by heat.

ANNE JOFFÉ.
A. F. JOFFÉ.

Physical-Technical Institute,
Leningrad.
July 10.

[1] H. Dember, *Phys. Z.*, **32**, 554, 856; 1931.
[2] H. Teichmann, *Proc. Roy. Soc.*, A, **139**, 105; 1933.
[3] R. Deaglio, *Z. Phys.*, **83**, 179; 1933.
[4] Anna Joffé and A. Joffé, *Z. Phys.*, **82**, 754; 1933.
[5] A. L. Hughes and L. A. Du Bridge, "Photoelectric Phenomena", 302; 1932.

Magnetic Moment of the Proton

THE spin of the electron has the value $\frac{1}{2}\cdot\frac{h}{2\pi}$, and its magnetic moment has the value $2\frac{e}{m_e c}\cdot\frac{1}{2}\cdot\frac{h}{2\pi}$, or 1 Bohr magneton. The spin of the proton has the same value, $\frac{1}{2}\cdot\frac{h}{2\pi}$, as that of the electron. Thus for the magnetic moment of the proton the value $2\frac{e}{m_p c}\cdot\frac{1}{2}\cdot\frac{h}{2\pi}$ = 1/1840 Bohr magneton = 1 nuclear magneton is to be expected.

So far as we know, the only method at present available for the determination of this moment is the deflection of a beam of hydrogen molecules in an inhomogeneous magnetic field (Stern-Gerlach experiment). In the hydrogen molecule, the spins of the two electrons are anti-parallel and cancel out. Thus the magnetic moment of the molecule has two sources: (1) the rotation of the molecule as a whole, which is equivalent to the rotation of charged particles, and leads therefore to a magnetic moment as arising from a circular current; and (2) the magnetic moments of the two protons.

In the case of para-hydrogen, the spins of the two protons are anti-parallel, their magnetic moments cancel out, and only the rotational moment remains. At low temperatures (liquid air temperature), practically all the molecules are in the rotational quantum state 0 and therefore non-magnetic. This has been proved by experiment. At higher temperatures (for example, room temperature) a certain proportion of the molecules, which may be calculated from Boltzmann's law, are in higher rotational quantum states,

mainly in the state 2. The deflection experiments with para-hydrogen at room temperature allow, therefore, the determination of the rotational moment, which has been found to be between 0·8 and 0·9 nuclear magnetons per unit quantum number.

In the case of ortho-hydrogen, the lowest rotational quantum state possible is the state 1. Therefore, even at the lowest temperatures, the rotational magnetic moment is superimposed on that due to the two protons with parallel spin. Since, however, the rotational moment is known from the experiments with pure para-hydrogen, the moment of the protons can be determined from deflection experiments with ortho-hydrogen, or with ordinary hydrogen consisting of 75 per cent ortho- and 25 per cent para-hydrogen. The value obtained is 5 nuclear magnetons for the two protons in the ortho-hydrogen molecule, that is, 2·5 (and not 1) nuclear magnetons for the proton.

This is a very striking result, but further experiments carried out with increased accuracy and over a wide range of experimental conditions (such as temperature, width of beam, etc.) have shown that it is correct within a limit of less than 10 per cent.

A more detailed account of these experiments will appear in the *Zeitschrift für Physik*.

I. ESTERMANN.
R. FRISCH.
O. STERN.

Institut für physikalische Chemie,
Hamburgischer Universität.
June 19.

Gravitational Field of an Electron

IN 1926, Einstein suggested[1] that the gravitational equations in an electromagnetic field should be taken as

$$K_{pq} - \tfrac{1}{4} g_{pq} K = -8\pi E_{pq},$$

where E_{pq} is the electromagnetic energy-tensor.

The solution of this equation for the radially symmetric field

$$ds^2 = -e^{\lambda}dr^2 - r^2 d\theta^2 - r^2 \sin^2\theta d\varphi^2 + e^{\nu}dt^2$$

is found to be

$$e^{-\lambda} = e^{\nu} = 1 - \tfrac{1}{3}\alpha r^2 - \frac{2m}{r} + \frac{4\pi\varepsilon^2}{r^2},$$

where α, m, ε are constants of integration. The constants m and ε may be interpreted (as in the well-known solutions of Nordström and Jeffery) as the mass and the charge of the electron respectively. But it is difficult to interpret the second term. The most probable interpretation is that the empty space-time is de Sitterean and not Galilean. The details of the solution will appear shortly.

J. GHOSH.

Presidency College,
Calcutta.

[1] *Mathematische Annalen*, Dec., 1926.

A Thermal Reaction between Chlorine and Formaldehyde

IT has been known for many years that chlorine reacts with the solid polymers of formaldehyde in the dark to give carbon monoxide and hydrogen chloride[1]. Furthermore, rapid reaction occurs in strong sunlight resulting in the formation of phosgene[1,2].

We have carried out some experiments with pure gaseous formaldehyde[3] and find that no measureable reaction takes place at 100°. At 150°, however, after a short induction period, a rapid reaction sets in accompanied by an increase in pressure. In such an experiment, starting with 191 mm. of formaldehyde and 183 mm. of chlorine, the pressure increased 148 mm. in 48 minutes. The reaction vessel had a volume of 156·5 c.c. and the dead space was reduced to very small dimensions by the use of a quartz spiral manometer. A known fraction of the gas was removed at this stage and cooled in a liquid air trap to condense the chlorine, formaldehyde and hydrogen chloride. The carbon monoxide which remained was collected by an automatic Töpler pump and analysed in a Bone and Wheeler apparatus. The condensate was dissolved in potassium iodide solution and the hydrochloric acid determined by titration, after removing the liberated iodine with thiosulphate. According to these analyses, 23·4 c.c. carbon monoxide and 44·8 c.c. hydrogen chloride at N.T.P. were formed in the reaction vessel. Both values are slightly greater than the theoretical amounts corresponding to a pressure increase of 148 mm., due to the fact that the induction period was extremely short in this case and some reaction had occurred before the first pressure reading could be taken.

However, it is apparent from the above as well as from other data not enumerated here that the reaction proceeds in the dark according to the following equation:

$$HCHO + Cl_2 \rightarrow CO + 2HCl$$

It is probable that a complex chain process is involved and a detailed study of the kinetics is in progress, with a view to further elucidation of the mechanism.

R. SPENCE.
W. WILD.

Physical Chemistry Department,
The University, Leeds,
June 27.

[1] A. Brochet, *C. R.*, **121**, 1156; 1895.
[2] W. Tishtchenko, *J. Russ. Chem. Soc.*, 479; 1887.
[3] M. Trautz and E. Ufer, *J. pr. Chem.*, **113**, 105; 1926.

Origin of Monochromatic Radiation

IT is a remarkable fact that a particle possessing two degrees of freedom of rotation in co-latitude θ and azimuth φ, where $\dot{\theta}$ and $\dot{\varphi}$ vary in a continuous manner, may give a stationary projection on the equatorial plane relatively to axes rotating in this plane with a certain *uniform* angular velocity.

Let $\dot{\theta} = \dot{\theta}_1 + (\dot{\theta}_0 - \dot{\theta}_1)e^{-\alpha t}$; $\dot{\varphi} = \dot{\varphi}_1 - (\dot{\varphi}_1 - \dot{\varphi}_0)e^{-\alpha t}$ where $\dot{\theta}_0\dot{\varphi}_0$. $\dot{\theta}_1\dot{\varphi}_1$ are the initial and final angular velocities respectively. Using the relations $\theta = \int \dot{\theta}dt$, $\varphi = \int \dot{\varphi}dt$, it then appears that the projected path on the equatorial plane OXY will be

$$r = a \sin\left\{\left(\frac{\dot{\theta}_0\dot{\varphi}_1 - \dot{\theta}_1\dot{\varphi}_0}{\dot{\theta}_0 - \dot{\theta}_1}\right)t - \varphi\right\}\frac{\dot{\theta}_0 - \dot{\theta}_1}{\dot{\varphi}_1 - \dot{\varphi}_0}.$$

α has disappeared and relatively to axes rotating about OZ with a *uniform* angular velocity given by the coefficient of t within the bracket, the projected path will be

$$r = -a \sin\left(\frac{\dot{\theta}_0 - \dot{\theta}_1}{\dot{\varphi}_1 - \dot{\varphi}_0}\right)\varphi;$$

curiously enough, this relative path will appear stationary if the total fall of one angular velocity in latitude bears any simple relation to the rise of the other in azimuth.

Perhaps it is too ambitious to try to find some 'Victorian' mechanism to explain what has remained unassailed as a postulate for the past twenty years,

namely, that one quantum of monochromatic radiation is emitted by an atom during a transition between stationary states. If, however, the emission of light can be associated with rotation of the frame of reference, then here it is illustrated how the uniform frequency can occur during the gradual settling down of the atom after disturbance.

LEWIS SIMONS.

Birkbeck College,
University of London.
June 9.

Separation of Forms of Vitamin A based on the Antimony Trichloride Reaction

WITH reference to the recent communication from Prof. Karrer's laboratory[1] describing the separation of vitamin A into two fractions by means of calcium hydroxide, we may recall that this separation was effected by us about two years ago[2,3], using, however, fuller's earth.

Saponified liver extracts in petroleum-ether are treated with small quantities of fuller's earth. The '580' chromogene is adsorbed much more quickly, and in order to get this pure such a quantity of earth is added that part of the '580' remains in solution. The adsorbed '580' chromogene can be eluted by alcohol.

If a pure '620' chromogene is wanted, more earth is added, and as a result the '620' remains in solution (too much earth causes absorption of both chromogenes). Only the '620' chromogene shows absorption at 328 mμ and has growth promoting activity. We also found that solutions containing the fraction with only the 580mμ band (with antimony trichloride), very soon showed absorption at 620 mμ.

M. VAN EEKELEN.
A. EMMERIE.
H. W. JULIUS.
L. K. WOLFF.

Laboratory of Hygiene,
University, Utrecht.
July 5.

[1] NATURE, **132**, 26, July 1, 1933.
[2] *Acta Brevia Neerlandica*, **1**, 8; 1931.
[3] *Proc. Kon. Akad. Wetenschap. Amsterdam*, **35**, No. 10; 1932.

Constitution of α-Carotene

RECENTLY we prepared α-carotene[1] in pure form. Ozonisation of α-carotene yields geronic and isogeronic acid. The result of the ozonisation proves that the formula III formerly proposed by us (*Helv. Chim. Acta*, **14**, 617, 1931) is correct.

Our former attempts[2] to isolate these two acids from the reaction products after ozonisation undoubtedly failed because there was only a very small amount of α-carotene available at that time; moreover, the old method of repeated adsorption on fuller's earth was accompanied by considerable decomposition and change of the pigment.

P. KARRER.
R. MORF.
O. WALKER.

Chemical Institute,
University, Zurich.
July 15.

[1] *Helv. Chim. Acta*, **16**, 641; 1933. NATURE, **132**, 26, July 1, 1933.
[2] *Helv. Chim. Acta*, **15**, 490; 1932.

Miracidia of the Liver Fluke for Laboratory Work

IN view of certain inquiries which have reached us lately it may be useful to publish briefly a procedure which has been in practice in Prof. Graham Kerr's department in Glasgow for many years.

Gall bladders from sheep livers infected with *Fasciola hepatica* are brought from the slaughter house to the laboratory and the contents of several are rinsed out with tap water into glass basins. The sediment, which contains eggs of the liver fluke, is washed with tap water until the washings are clear; this is more quickly accomplished with the aid of a slow centrifuge. The eggs are thinly spread over the bottoms of the dishes and left in tap water, the dishes covered, in a warm place. If the water becomes foul it must be changed again; this is usually necessary for several days unless the centrifuge is used. The time taken for the miracidia to develop varies with the temperature at which they are kept. At about 16° C. they should be ready to hatch in 6–8 weeks; at about 25° C. they need only 2–3 weeks. When the miracidia are ready, hatching is brought about by suddenly placing the eggs in a comparatively large quantity of water at a lower temperature—a drop of the sediment in a watch glass of cold tap water for example. This is done half an hour or so before the larvæ are required for demonstration or the infection of *Limnæa truncatula*. If the snails are to survive such treatment, care must be taken not to allow too many miracidia to attack them. Incidentally, flame cells in action may be very well seen in the active miracidium while it is still in the egg if it is examined with an oil immersion lens having a sufficiently long working distance (such as the Winkel-Zeiss 2·2 mm. lens).

It is usually stated that the incidence of liver rot in sheep is seasonal, so that it may be as well to add that we have never had any difficulty here in obtaining eggs capable of developing at any time in our academic year (October to June).

This method seems preferable to that described by Dr. N. B. Eales[1] in which the eggs were dissected out from the bodies of the flukes.

MARGARET W. JEPPS.

Department of Zoology,
The University,
Glasgow.

[1] *Eales*, N. B., NATURE, **125**, 779, May 24, 1930.

Anatomy and Affinities of *Tarrasius problematicus*

Tarrasius problematicus from the Carboniferous of Glencartholm, Dumfriesshire, was first figured and described by Traquair[1]. According to him, it is a fish with the dorsal fin continuous with the caudal, and the caudal with the anal; the anterior part of the body is naked, and the posterior covered by a shagreen of minute lozenge-shaped ganoid scales, which do not overlap, and are very like those of an acanthodian; the pectoral fins are obtusely lobate and there are no pelvic fins; the notochord is persistent and the radials of the unpaired fins are greater in number than the neural arches. The structure of the skull was described very vaguely as having delicately ornamented mandibles and frontals, and large but indefinite bones in the opercular region.

The affinities of this fish have always been doubtful. Zittel[2] considered it to be a dipnoan, but Traquair[1] and others related it to the Crossopterygii.

Recently I have made a re-examination of the British Museum, Geological Survey, and Royal Scottish Museum specimens of this fish, and made sections of the scales of specimens in the Leeds City Museum. While confirming Traquair in all the above mentioned facts, I have been able to add the following information. The microscopic structure of the scales is of the type characteristic of Palæoniscids, as described by Goodrich[3], consisting of a layer of cosmin between a layer of ganoine and a layer of bone, and the whole scale having grown by additions of concentric layers of ganoine on the outer and bone on the inner surface. The internal skeleton of the lobed pectoral fin is easily discernible owing to the absence of scales, and consists of five radials arranged in the form of a fan, thus is more characteristic of actinopterygians than crossopterygians. The radials of the continuous fins arise between the ends of the neural and hæmal spines, and do not articulate with them as in Crossopterygii and Dipnoi. The bones of the head show a maxilla with a narrow anterior end and an expanded posterior portion characteristic of palæoniscids. There is no pineal foramen visible, and the opercular bones, although imperfect, show outlines which are quite consistent with those of other palæoniscids. The general ornamentation of the maxilla, mandible, and frontals is also very suggestive of this group. The lepidotrichia do not branch, in this resembling *Holurus*, a palæoniscid in which also the dorsal fin has a much elongated base. There can, therefore, be very little doubt that *Tarrasius* is merely a palæoniscid which has become eel-like in form.

These new facts concerning *Tarrasius* throw considerable light on the phylogenetic position of *Polypterus*. Goodrich[4] has shown that *Polypterus* has many characters in common with palæoniscids. The occurrence of an indubitable palæoniscid (*Tarrasius*) with a lobed pectoral fin, no fulcral scales, a continuous median fin, and a diphycercal tail, on which the scales do not suddenly alter their direction, removes most of the discrepancies between *Polypterus* and this group, and confirms Prof. Goodrich's views on its systematic position. *Polypterus* is a specialised palæoniscid, which has survived to the present day.

A full account of the anatomy and affinities of *Tarrasius* will be published elsewhere.

J. A. MOY-THOMAS.

Department of Zoology,
The University,
Leeds.
June 16.

[1] *Trans. Roy. Soc. Edin.*, 1881. *Ann. Mag. Nat. Hist.*, 1890.
[2] "Handbuch der Palæontologie", 1887.
[3] *Proc. Zool. Soc.*, 1908.
[4] *Palæobiologica*, 1928.

Growth in Muscle

IN the growth of the eye muscles of plaice, I have made an observation which may concern the general problem of muscular development. When transverse sections were taken of the head of a young plaice 4 cm. long, its internal rectus was seen to consist of 42 distinct fibres. Similar sections were taken of plaice of lengths increasing up to 10 cm. and it was found that up to 8 cm. the muscle grows in stoutness by the thickening of the fibres—a fibre in the internal rectus of a 8 cm. plaice being twice as thick as the fibre of a 4 cm. fish: the number of the fibres in the muscle showed practically no increase. But a section through a plaice 10 cm. long revealed a sudden proliferation in the number of fibres so that about 342 could now be counted. Here is evidence therefore that the muscle fibres, originally formed from the embryonic cells of the mesoderm, do not keep to a constant number all through life, and that a muscle grows not only by a thickening of the component fibres as happens in the early stages of plaice, but also by a multiplication of them as happens later.

D. D. DASEN.

Department of Oceanography,
University of Liverpool.
June 2.

The International Phenological Journal, *Acta Phænologica*

IN the middle 'twenties, three letters on behalf of the Phenological Committee of the Royal Meteorological Society appeared in NATURE, in which was urged the great importance, not least for agriculture, of more systematic correlation between the workers in different countries.

In the last of these letters[1] we were able to report an unexpectedly large and sympathetic response, revealing the existence of fully 3,000 stations in ten European countries, the United States and elsewhere, not a few in the south temperate zone, besides isolated observers working independently. Moreover, agricultural authorities in all directions were awakening to the importance of the subject, yet each developing its own schemes. Hence, from more than one authority the necessity for an international phenological journal was urged, thus also preparing the way for an international congress.

The response of the Dutch Phenological Society under its then president, Dr. H. Bos, was particularly practical. Its position relative to two other well-organised networks, Belgium under Prof. Vanderlinden, and Germany with adjacent areas under the veteran worker, Dr. E. Ihne of Darmstadt, accentuated the disadvantages arising from lack of co-ordination. Its own organisation, under the guidance of Dr. Bos and now of Dr. Pinkhof, is exceptionally complete. From them, invitations were broadcast to phenologists in all countries, inviting their co-operation in such a journal. Widespread approval was expressed and accordingly, *Acta Phænologica* came into being in July 1931, with six issues yearly. These form a volume with a total of 175 to 200 pages, large octavo. Contributions are accepted in either French, German or English. Its success has been marked save in one fundamental respect; so far, the number of subscriptions falls far short of actual cost, for its appearance coincided with the world-wide 'slump'. No start, indeed, would have been possible had it not been for the whole-hearted co-operation of the Hague publishing firm, Martinus Nijhoff. Recognising the importance of the venture, this firm guaranteed, financially, its appearance for the first three years.

Failure to establish the journal financially is a misfortune, which may mean indefinite postponement of phenological unification, upon which more than anything else will depend preparation of the ground for establishing the universal bond which would result from an international phenological congress.

These facts justify a fresh appeal and on surer grounds than was possible in 1926. Simply to cover printing and postal expenses a further hundred annual subscribers are required. The cost, including postage, is seven Dutch guilder, or 11*s.* 6*d.* yearly, payable to Martinus Nijhoff, with an extra 6*d.* for cheque from abroad. At present neither contributors nor the editorial committee receive emolument.

The Dutch Society makes a special contribution quite out of proportion to its limited membership. Can we not hope that scientific workers and their societies in other lands will also lend a hand as subscribers and donors, thus helping over its opening stages a fresh international venture which is rendering a service not only in purely scientific but also increasingly in economic directions ?

J. EDMUND CLARK
(Sec. Roy. Met. Soc. Phenological Committee).
Royal Meteorological Society,
London, S.W.7.

[1] NATURE, **117**, 413, March 20, 1926.

A New Method of Fluorination of Organic Compounds

H. MOISSAN introduced silver fluoride as a fluorinating agent. Meslans[1] obtained $CH_3.CO.F$ by the action of anhydrous zinc fluoride on $CH_3.CO.Cl$. Prof. F. Swarts of Ghent introduced SbF_5 and a small quantity of bromine or $SbCl_5$ as catalyst as well as Hg_2F_2 in the fluorination of organic compounds.

The ethyl and methyl esters of chloroformic acid are well known though the free acid cannot be isolated. The affinity of fluorine for carbon is enormous, as is demonstrated by the remarkable stability of the covalent linkages of the two atoms. The fluocarbonic esters are expected, on this account, to be more stable than the chloro-derivatives.

Attempts to prepare them by any of the above methods were unsuccessful, explosive decomposition taking place. Dr. P. B. Sarkar, working in the Inorganic Department of this College, has been able to isolate recently the ethyl and methyl esters of fluo-formic acid by the action of anhydrous thallous fluoride in the cold on the corresponding esters of chloro-carbonic acid and subsequent distillation of the reaction products.

Ethyl fluo-carbonate	$-O=C<^{OC_2H_5}_{F}$	B.P. 57°C	$d_{33°}=1{\cdot}06$, difference = 36°, $d_{20°}=1{\cdot}13$
Ethyl chloro-carbonate	$-O=C<^{OC_2H_5}_{Cl}$	B.P. 93°C	
Methyl fluo-carbonate	$-O=C<^{OCH_3}_{F}$	B.P. 40°C	diff. = 31°
Methyl chloro-carbonate	$-O=C<^{OCH_3}_{Cl}$	B.P. 71·4°C	

The substitution of chlorine by fluorine lowers the boiling point by 34° C.; the methyl ester being denser than the ethyl ester. The same is the case with the chloro-esters.

Comparison of the boiling points of acid-fluorides and acid-chlorides already known gives the following:

$CH_3.CO.F$	20·8°C	diff.
$CH_3.CO.Cl$	50·9°C	30·1
$C_2H_5.CO.F$	44°C	36°
$C_2H_5.CO.Cl$	80°C	
$C_3H_7.CO.F$	65°C	36°
$C_3H_7.CO.Cl$	101°C	

The details of the above preparation will be published in the *Journal of the Indian Chemical Society*.

P. C. RÂY.
University College of Science and Technology,
92, Upper Circular Road, Calcutta.
May 26.

[1] *C. R.*, **114**, 106.

Interaction between Cosmic Rays and Matter

LAST year I showed by means of a coincidence method that a secondary corpuscular radiation is generated when cosmic rays pass through matter[1]. From the beautiful experiments of Blackett and Occhialini we know now that these secondary particles are produced in so-called 'showers'. This can also be shown by the method of coincidences; moreover, if a coincidence is observed between counters arranged in a triangle, we may conclude with a high degree of certainty that we have to do with a shower originating from a point in the neighbourhood of the counters[2]. The method of triple coincidences therefore offers a very useful means for investigating the frequency of occurrence of the showers.

Up to the present, the following results have been obtained:

(1) The showers occur more frequently in elements of high atomic number; the ratio of the numbers of coincidences caused by thin layers of lead, iron, aluminium of the same weight per cm.^{2} is 4 : 2 : 1 approximately[3].

(2) The number of showers emerging from a layer of lead, as a function of the thickness of this layer, increases at first, reaches a maximum at a thickness of about 20 gm./cm.^{2} and then decreases very rapidly; at 100 gm./cm.^{2}, for example, the frequency of the coincidences is less than one half of the maximum value. We conclude that the radiation which causes the showers has a mean range of a few centimetres in lead. It follows that this radiation cannot be identical with the primary cosmic rays.

(3) When the thickness of the layer is further increased, the frequency of the emerging showers decreases very slowly. The most probable hypothesis to explain this seems to be to assume that a further production of the rays which cause the showers takes place in the layer; these rays are therefore to be regarded as a secondary radiation of the primary cosmic rays, the equilibrium value of which is roughly three to four times greater in air than in lead.

(4) The shower-producing rays are more readily absorbed by elements of higher atomic number. When 24·5 gm./cm.^{2} of lead is placed over the counters, 70 ± 3 coincidences per hour are observed; this number was reduced to $36{\cdot}7 \pm 1{\cdot}4$ by a further sheet of lead of 39 gm./cm.^{2} on top of the first one but only to $52{\cdot}3 \pm 1{\cdot}7$ by a sheet of aluminium of the same weight per cm.^{2} and in the same position. From this and from (1) we conclude that the absorption of these secondary rays by an element and the number of showers which they produce depend in the same way on the atomic number. Thus it seems that the production of showers must be the main reason for their absorption. This is in agreement with the consideration that these rays should have an energy of at least some milliards of electron-volts, which could not be absorbed by a few centimetres of lead in the ordinary way.

(5) That the equilibrium value of the secondary radiation is lower in elements of high atomic number may be explained by their greater absorption, if we assume that the rate of production is roughly the same in all elements; which seems plausible from the experiments on the absorption of the primary rays.

BRUNO ROSSI.

Physical Institute,
University of Padova,
Italy. July 3.

[1] B. Rossi, *Phys. Z.*, **33**, 304, 1932.
[2] B. Rossi, *Atti. R. Acad. Naz. Lincei*, in the press.
[3] B. Rossi, *Z. Phys.*, **82**, 151; 1933.

Penetrating Radiation from Thunderclouds

IN their recent paper[1] B. F. J. Schonland and J. P. T. Viljoen throw doubts on the ability of ionisation methods to detect the penetrating radiation from thunderclouds. However, this method has been in use at this station during the thunderstorm season October 1932–April 1933 with practically the same results as those obtained by Schonland and Viljoen. The order of the effect was about 1 per cent, as in their case, but storms had an effect when less than 30 km. distant. Storms less than 15 km. distant did not appear to have any effect and no appreciable diminution in the ionisation was observable from the majority of overhead storms. An important effect noted was that storms to the west of the station had more effect on the ionisation than those to the east, a fact which tends to confirm the electron spray hypothesis. The closer distance of approach of the storms, too, probably finds an explanation in this hypothesis as put forward by Hulbert[2], for the station is practically located on the magnetic equator.

Some evidence of a diurnal variation of 1–2 per cent in the radiation was also found (altitude of station 11,000 ft.) and practically in phase with the diurnal variation of the atmospheric potential gradient. Whether this is only a coincidence or due to a maximum of thunderstorm activity in the Amazon basin is yet to be proved, but investigations are in progress to endeavour to elucidate this point.

J. E. I. CAIRNS.

Observatorio Magnetico, Huancayo, Peru.
(Department of Terrestrial Magnetism,
Carnegie Institution of Washington).
June 13.

[1] *Proc. Roy. Soc.* A., May, 1933.
[2] *Phys. Rev.*, **37**, 1; 1931.

Recording Wireless Echoes at the Transmitting Station

IN their communication to NATURE of May 6, p. 657, Prof. S. K. Mitra and H. Rakshit claim to have succeeded in recording wireless echoes by the method of Breit and Tuve, with the receiver at the transmitting station.

Since April 1931[1] I have been using an apparatus I devised which permits such recording, without the difficulty mentioned by these authors of an apparent diminution of echoes as the receiver is brought near the transmitter. My device consists of a transmitter with a valve of, say, 100 watts, modulated by alternating current (commercial 50-cycle power supply) to transmit periodic signals of, say, 1/1000 sec. duration. The receiver, placed in the same room, is provided by a two-stage screen-grid high-frequency amplifier, one stage detector (for plate characteristic) and a final one-stage continuous current amplifier. The observations are made by a cathode ray oscillograph, the spot of which is deflected along the time axis by the same alternating current. The detector valve is made to oscillate on a frequency little different from that of the transmitter: then beat curves are observed on the oscillograms corresponding to the reflected wave trains (Fig. 1): the position of the beat curves is a measure of the reflection height.*

In my experiments I have never observed any increase of echoes amplitude by increasing the distance between the two stations (up to 500 m.): this

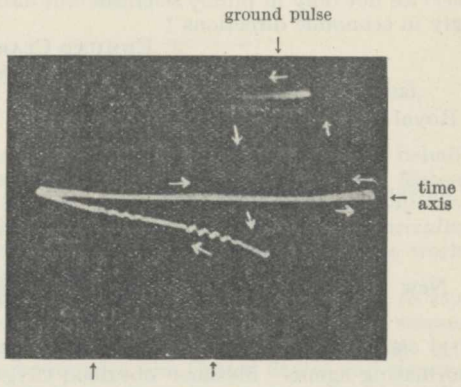


FIG. 1.

confirms the opinion of R. A. Watson Watt and L. Bainbridge-Bell[2] that the diminution observed by Mitra and Rakshit is due to the overloading of the receiver by the ground-pulse.

IVO RANZI.

Physical Institute 'A. Righi',
University of Bologna,
Italy.
May 31.

* For synchronisation between transmitter and receiver, the beat curves show by their movement the continuous phase variations, which the echoes sometimes present.

[1] *Nuovo Cimento*, p. 258; 1931. *Rendiconti Accademia Lincei*, vol. 16, p. 40; 1932.
[2] NATURE, **131**, 657, May 6, 1933.

Spin and Statistics of the Neutron

THE experiments of Stern show that the magnetic momentum of the proton is greater than it should be if the proton were an elementary particle. Therefore the proton may be considered as 'consisting' of a neutron and a positron. If the Anderson positron is identical with the Dirac-Oppenheimer anti-electron, then according to the symmetry of the positive and negative electricity in Dirac's theory of 'holes', the positron should have a spin momentum of $\frac{1}{2}$ and should obey Fermi statistics. (This view may be confirmed by the fact that Dirac's theory of 'holes' in all probability gives an explanation of the continuous β-spectrum, especially of the sharp upper limit.) This leads at once to the conclusion that, contrary to the present hypothesis, the neutron should have an integral spin momentum and should obey Bose statistics.

TH. SEXL.

Institute for Theoretical Physics,
University of Vienna.
June 20.

Research Items

Horned Cairn, Goward, Co. Down, Ireland. The excavation of a horned cairn with unusual features on Goward Hill (680 ft.), 2 miles east of Hilltown, Co. Down, in May 1932, by Messrs. Oliver Davies, E. Estyn Evans and Miss Gaffikin is described in *Man* for July. The maximum measurements of the cairn are about 115 ft. × 50 ft. × 6 ft. the material being loose stones with some earth. The original shape seems to have been somewhat parabolic, but the limits are irregular, especially on the south. There are no traces of a peristalith, except possibly at the north-east angle. Extending beyond the horns are three aligned chambers with no covering, but full of earth and stones. An unusual feature is the disposition of the horns, the north horn having six uprights and the south three with two portal stones between. The diameter of the circle is 37 ft. The three chambers are separated by two sills formed of single blocks reaching to half the height of the chambers. The west end is blocked by a larger stone 4 ft. 8 in. high. Flanking the three stones are three pairs of jambs, on an average 4 ft. 6 in. high, and against them are the orthostates of the central and west chambers, tilted slightly inward. No parallel to this method of construction is known except in a horned cairn just north of Belfast. Both jambs and sidewalls are carried to a uniform level. The east chamber presents several abnormal features, and was further differentiated from the other chambers by its contents. Above a slab laid horizontally just in front of the sill were twenty-two packets of ox-bones. The pottery, falling into two groups, coarse and fine, suggests neolithic parallels but, as a whole, appears to belong to a Hallstatt–la Tène complex; but the ox-bones are thought to be more modern and may be the relics of a sacrifice, such as the ox-sacrifices of the west of Scotland and the Isle of Man, known to have been offered within the last three hundred years.

Atlantis. Plato's Atlantis is the subject of a communication by Dr. W. A. Heidel to the American Academy of Arts and Sciences (*Proceedings*, vol. 68, No. 6) in which a new suggestion as to its derivation is put forward, based on an examination of the geographical conceptions current in Greece in the sixth and fifth centuries, B.C. There are no references to Atlantis in ancient times which are not derived from the statement of Plato. Plato relied upon two principal geographical complexes, the first connected with the supposed shoals lying beyond the Straits of Gibraltar, and the second a series of catastrophes dividing the history of the human race into periods. The latter conception was certainly known to Hekatæus. Early Greek geographical speculation was interested in the limits of the land, as is shown by the story of the Pillars of Hercules, and as a consequence in the question whether the ocean was continuous or interrupted by a series of land-bridges. Hence the attraction of the circumnavigation of Africa. The prevailing view was that Asia and Africa were united at points other than Suez, the point of connexion in Asia being India, and only two continents were recognised. Herodotus regarded the distinction of Asia and Libya as scarcely justified, and implied that Egypt and Libya belonged to Asia. The discovery of most of Asia is attributed by Herodotus to Darius, under whom Skylax, sailing down the Ganges (it is suggested), reached the utmost limits of the continent. Sesostris was said by tradition to have reached the bounds of Asia, where his ships were stopped by shallows. These, it is suggested, represented in tradition the remains of a cataclysm which had engulfed the ancient land-bridge between Asia and Africa, a parallel to conditions at the Pillars of Hercules. It was from this geographical speculation, which was probably known to Hekatæus, that Plato may have derived his Atlantis.

Census of Rooks in the Midlands. A census of rooks in Nottinghamshire, Leicestershire, Rutland, Derbyshire and Lincolnshire, was made by A. Roebuck during the early months of 1928, 1929 and 1930. In this total area of 5,305 square miles there were 1,421 rookeries, containing in all 64,133 nests, representing a breeding population of 128,266 rooks. This means, in that area, no more than one rookery, with an average of 45 nests, to every 3·7 square miles of country, or one rook to every 23 acres of arable land (*British Birds*, 27, 4, June, 1933). But after the breeding season the total number of birds would be increased three times, allowing an average of four young to each nest; and accordingly food hunting becomes correspondingly intense, and journeys are restricted to within short distances of the rookeries. The author's description suggests that rooks do not travel far for food, since there is no overlapping of feeding grounds if the rookeries are several miles apart, nor do the rooks range into the centre of Nottinghamshire, which is free from rookeries. It would be interesting to know if the same statement applies to the food journeys of the birds from their winter roosts, but the present paper confines itself to the nesting rookeries.

A Soil Arachnid from Australia. At the inaugural meeting of the recently formed Entomological Club of South Australia, held on April 20 (president, Dr. James Davidson) the secretary, Mr. H. Womersley, exhibited mounted specimens of an interesting soil-inhabiting microthelyphonid *Kœnenia mirabilis*, Grassi. The specimens were originally taken under stones in Mr. Womersley's garden but later more were found in the same habitat on the lower slopes of Mount Osmond, Adelaide. In 1901, Dr. H. J. Hansen (*Entom. Tidskt.*, p. 193) surveyed critically this group of arachnids and enumerated seven species from various parts of the world, Europe, South America, North Africa and Siam. Several of the species were new and some of the others had been erroneously referred to Grassi's species. In discussing the geographical range, Dr. Hansen was very dubious as to the probable occurrence of the European species in remote parts of the world. Thanks to Dr. Hansen's critical studies, it can now be stated that the species from Europe does occur in Australia. All the specimens so far found in the Adelaide district agree in all the minute characters given by Hansen to distinguish it from the others. It is to be noted, however, that they have been found only in areas largely occupied by man and are probably therefore introduced and not indigenous. Whether truly indigenous forms are to be found in the virgin country still remains to be determined.

Descriptions of Fungi Imperfecti. The group 'Fungi Imperfecti' forms a vast reservoir for species the conidial forms only of which are known. The numbers

of fungi included therein are so large as to make classification and identification difficult. Mr. E. W. Mason is making a very useful contribution to our knowledge of this group by publishing an "Annotated Account of Fungi received at the Imperial Mycological Institute". The second fascicle of List II appeared in March 1933 (price 5*s*.), and contains descriptions of fungi belonging to the genera *Coniosporium*, *Papularia*, *Pseudocamptoum*, *Acrimoniella*, *Chlamydomyces*, *Melanospora*, *Monotospora*, *Trichocladium*, *Nigrospora* and *Haplographium*. The account is well illustrated with line diagrams and an extensive bibliography is appended.

Alaskan Forest. An interesting investigation has been carried out by Prof. Robert F. Griggs of the George Washington University as a result of which it is reported (Science Service, Washington, Dec. 23, 1932) that the forest of Alaska is extending northwards. Material, collected from a bog near Kodiak by Prof. Griggs, was analysed by his associate, Dr. Paul W. Bowman, who described the results of his work to a meeting of the Ecological Society of America at Washington. The bog is 13 ft. deep, and situated several miles within the edge of the spruce forest and surrounded by well-grown trees. The upper 3 ft. of this deposit were too soupy to permit the collection of material for analysis, but below this level core-cuttings were made all the way to the bottom. Microscopic examination of this material showed great numbers of spores, but they all belonged to several species of ferns, with exceedingly few pollen grains from trees. This is taken to indicate that when the lower ten feet of peat were being formed, the bog stood in open country with ferns dominating the vegetation, and that the forest has moved in and taken possession of the land since that time. Prof. Griggs stated that his most striking observations were made at Kodiak, which is now beyond the timbered area, though old records indicate that areas now heavily forested were treeless a few generations ago. The trees at the edge of the forest are small and squat, suggesting an adverse climate, but when examined they were found to be growing as rapidly as the same species a thousand miles within its borders to the south-east. None of the trees within a mile of the forest border at Kodiak is more than a hundred years old. There are no fallen logs or other remains of trees older than the present generation. Three miles back from the forest border the trees are more than three hundred years old and have attained great size. Dead trees and fallen logs are present as in ordinary forests. Instead of being held in check by climatic factors, this forest is rapidly migrating into new territory.

Arctic Ice in 1932. The "State of the Ice in the Arctic Seas 1932" (*Det Danske Meteorologiske Institut Aarböger*) records a year that shows few departures from the normal in most parts and in others less ice than usual. The west coast of Spitsbergen was almost free from ice from May until September. The north coast was clear until late August, but the east of the archipelago had its usual amount of ice. The previous winter had been open on the west coast. In the Barents Sea conditions were favourable in summer and Franz Josef Land was almost clear in June. In the Kara Sea there was less ice than usual. On the east of Greenland, conditions differed little from the normal until August, when the ice-belt became very narrow and easy to traverse. The west coast had little ice. The pack reached northern Iceland in March. On the Newfoundland Banks bergs were very numerous in May but rapidly decreased in number in June. Baffin Bay had fewer bergs than usual. Hudson Strait had little ice in summer. In the Bering and Beaufort Seas no great departure from the normal was recorded. An ice-breaker failed to reach Wrangel Island, but for the first time on record a vessel, the Russian ice-breaker *Sibiriakov*, made the North-East Passage without having to winter. The ship left Archangel on July 28 and reached the Bering Sea on October 1.

Geology of Northern Siberia. So little is known of the geological history of this region that the investigations of B. N. Rozkov in the Norilsk and Severna districts in the north-western part of the Jenisei-Lena platform are of special interest (*Bull. Soc. Nat. Moscou, sect. géol.*, 10 (2), 268–294; 1932.) The formations from the base upwards are (*a*) limestones and shales with brachiopods, corals and graptolites, of Upper Ordovician and Lower Silurian age; (*b*) the Tungus series, of Upper Carboniferous and Permian age, resting on the eroded surface of the older rocks, and consisting of productive coal measures followed by tuffs and lavas of basaltic composition. Along the Severna River basic effusive rocks up to 4,000 ft. in total thickness overlie the older tufts and may be wholly or in part of Mesozoic age. Intrusions of gabbro and related rocks are widely distributed throughout the area and with them sulphide deposits of the iron-copper-nickel association are found locally. The rocks have been but little disturbed by movements. Gentle folding occurred at the close of the Palæozoic and there is later faulting which is thought to be of Mesozoic age.

A Self-Illuminating Hand Magnifier. Difficulty is experienced in the use of a hand-magnifier of high power in the matter of illumination, for the lens has to be close to the object and the necessary light cannot for the most part gain access. In order to obviate this difficulty, Messrs. R. and J. Beck, Ltd., 68 Cornhill, London, E.C.3, have devised the 'Beck Luminex Magnifier' in which a small electric torch is housed in the handle, the light from which, controlled by a spring switch, is condensed by a specially shaped reflector, which also carries the lens, on to the area to be observed, which is evenly illuminated. The magnifying power is $\times 10$ or $\times 15$: one model has a fixed focus, another a focusing motion by means of a screw so that the magnifier may rest upon the object. A third model is arranged as a compound microscope with a magnifying power of $\times 40$. Various graduated scales and squared discs on glass are supplied for use with the instrument so that measurements may be made and counting facilitated. We have tested the 'Luminex Magnifier' and find it to be a convenient instrument, useful, for example, for examination of the skin and of photographic films, for biological field work, and as a fabric prover or thread counter. The various parts are standardised and replacements of lamps and batteries can be obtained anywhere. The instrument is heavily nickel-plated, is strongly made and therefore suitable for workshop use, and in leather case is of handy pocket-size.

Experiments on the Melting of Metals. There is evidence that the melting of metals may be accompanied by complicated phenomena covering a considerable temperature range. Webster (*Proc. Roy.*

Soc., A, June) has made experiments which seem to show the persistence of nuclei in metals at temperatures well above the melting point. The metal was heated in a crucible and maintained at a temperature above the melting point. On cooling there was, in general, considerable undercooling before solidification set in. The amount of undercooling was found to increase with increase in the temperature to which the melt had been raised; it was nearly independent of the times for which the different temperatures were maintained. It appears that nuclei persist in the melt and determine the subsequent solidification but that these nuclei disappear as the temperature is raised above the melting point. Similar results were obtained for bismuth, lead and tin, though in the case of tin a few degrees superheating appeared to destroy the nuclei entirely. No undercooling was observed in the case of cadmium.

Motor-Car Cylinder Wear. A report has recently been issued by the Research Department of the Institution of Automobile Engineers on an investigation into the cause of the wear of engine cylinders, which leads to loss of power, increase in oil consumption and, eventually, costly replacements. Although it has hitherto been generally supposed that cylinder wear occurred most rapidly when starting up, no conclusive evidence on this point was forthcoming, and in addition, several explanations were put forward to account for the wear, such as deficiency of lubrication, and the dilution by petrol of the oil on the cylinder walls. Accordingly, experiments were started to explore systematically every possible cause. These experiments extended over about a year. In these it was found that dilution with petrol, even up to 90 per cent, did not produce accelerated wear, and that with cylinder wall temperatures of 125°–265° C. and under steady running, deficiency of oil was unlikely to be a factor of practical importance. It was also found that cylinder wear was practically independent of temperature over the same temperature range. On the other hand, delayed warming up, particularly if accompanied by scanty lubrication, resulted in a marked increase in cylinder wear and it was concluded that low cylinder wall temperature was the main cause of high wear. The increase in wear at low temperatures was also shown to be related to condensation on the cylinder walls of water from the products of combustion, and evidence was forthcoming which suggests that the effect of this water was to cause corrosion. In conclusion, the report suggests various possible ways of eliminating cylinder wear.

Astronomical Topics

New Comet. The fourth cometary discovery of the year (1933 *d*) was made on July 15 by Dr. Carrasco at the Madrid Observatory.

The following position is from U.A.I. Circ. No. 442:

1933	R.A. 1933·0	S.Decl.	Mag.
July $15^d21^h20{\cdot}0^m$ U.T.	$13^h10^m24^s$	12°43′	10·0

Daily motion -1^m32^s, N.56′

The comet is rather low in the evening sky, and better placed for southern observers; its northward motion may bring it to a more convenient position later on. It is Dr. Carrasco's second cometary discovery.

Norman Lockyer Observatory. The Director's report on the work of the Observatory for 1932–33 records steady progress in the investigations which are being undertaken by Dr. W. J. S. Lockyer and Mr. D. L. Edwards. These include spectral studies of certain bright hydrogen line stars, the determination of the spectroscopic parallaxes of *B* type stars and an intensive study of the variable spectrum of γ Cassiopeiæ. With the Frank McClean telescope, 66 negatives (average exposure 1 hour) of *B* type spectra were obtained, and with the Kensington telescope 154 negatives (average exposure 1¼ hours) of bright hydrogen line spectra. With the new Mond photographic equatorial, 32 photographs of clusters, nebulæ and star regions were secured. This is an excellent record of observational work.

The report of the Council of the Observatory refers to the outstanding event of the period covered by the report, namely, the inauguration by Sir Frank Dyson of the Mond photographic equatorial, the gift of Sir Robert Mond, in the presence of a large company of astronomers and friends of the Observatory. It is well to put on record the words of the chairman, Sir Richard Gregory, on that occasion. "The Norman Lockyer Observatory is unique in being the only Observatory in the Kingdom maintained by a Corporation under the Companies Act. It is the object of the Observatory Corporation not to make financial profit or pay dividends, but rather to secure the profits of discovery from observations of the stars." Since its formation nearly twenty years ago, the Observatory has been equipped and carried on entirely by private donations. During these years a high standard of achievement has been maintained and with the new equipment an additional path of astronomical research will be explored.

Astronomical Notes for August. Venus, Mars and Jupiter are all evening stars, but too low down, and Mars too far from the earth, for convenient observation. Venus and Jupiter are very near each other on August 17 at 11 a.m. It would be worth while looking for them in daylight. Saturn is in opposition on August 5, but its south declination of 18° is a hindrance to observation. Uranus is well placed for observation, in Pisces, in the later part of the night. Mercury is fairly well placed as a morning star on August 19; it is 19° from the sun and 5° north of it.

There is an annular eclipse of the sun on August 21; the annular phase crosses Egypt, Arabia, India, Siam, Borneo, north Australia. The greater part of Europe, including the east coast of Norfolk, will see a partial eclipse. Attempts are to be made to determine the effect of the eclipse on wireless waves.

Two reappearances of stars occulted by the moon are visible under favourable conditions in London; a star of mag. 6·4 reappears on August 11 at 10.29 p.m. at angle 235°; and the double star Epsilon Arietis, mag. 4·6, reappears on August 12 at 10.49 p.m. at angle 208°; the two components will reappear in such rapid succession that the eye must not be moved from the telescope after seeing the first. There is a penumbral eclipse of the moon about sunset on August 5; the moon will be too low in England for useful photometric observations.

The Perseid meteors ('Tears of St. Lawrence') are usually visible for several days round about August 10; the radiant is highest after midnight, but moonlight is less troublesome before midnight.

Photosensitising Agent in 'Geel-dikkop' Phylloerythrin

By DR. CLAUDE RIMINGTON and J. I. QUIN
Onderstepoort Veterinary Research Laboratory, Pretoria, South Africa

AS reported recently[1], we are engaged upon the study of a disease 'geel-dikkop' or 'yellow-thick-head' in sheep, characterised by intense photosensitivity and a well-marked, generalised icterus. Our view, previously put forward, was that a special set of physiological conditions, both of the plant and of the animal, were necessary for the appearance of the disease. We have now pursued the study further upon chemical lines.

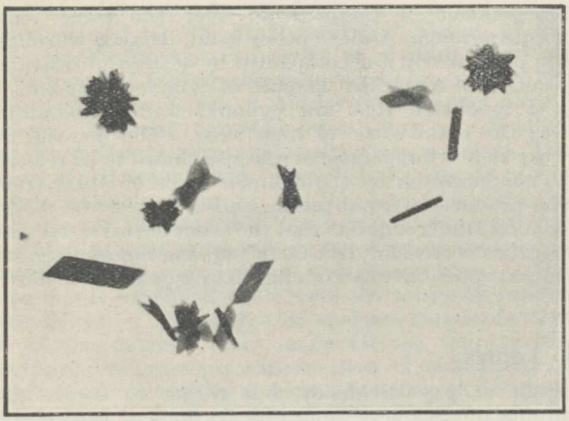


FIG. 1. Bile porphyrin from pyridine-methyl alcohol.

Since photosensitisation is a characteristic symptom, the first step, naturally, was to look for the photosensitising pigment. No porphyrins or pigments of the 'hypericin' type could be discovered in *Tribulus*, so it became necessary to turn to the animals' blood for the isolation and identification of the factor responsible.

FIG. 2. Symptoms of photosensitisation 30 minutes after intravenous injection of 0·1 gm. bile porphyrin.

In this we were hampered by the uncertain, even erratic, occurrence of the natural disease; an observation of fundamental importance was, however, made by the discovery[2] that simple ligature of the common bile duct in sheep gave rise to symptoms almost identical with those encountered in the natural disease, that is to say, generalised icterus and a marked photosensitivity followed by œdema of the unpigmented parts, especially the face, lips, etc., and later, necrosis and sloughing of the hardened skin. The serum of ligation icterus cases was investigated and a fluorescent substance with porphyrin-like properties and absorption spectra in ethereal and acid solution was found to be present. Normal sheeps' bile (laboratory flock) was found to contain traces of a similar, if not identical, pigment. In order to procure larger quantities of bile for isolation purposes, we introduced bile fistulæ instead of ligating the duct in a number of sheep and in every case it was found that within 48 hours after the operation, the concentration of porphyrin-like pigment in the bile had risen to about ten times that found in normal bile, probably owing to the ingestion of more green feed.

Conditions were such that bacterial growth in the fistula fluid and infection of the gall bladder were carefully avoided. The hypothesis that normal excretion might be largely in the form of a leuco-compound has been entertained but cannot, so far, be substantiated by direct experiment.

FIG. 3. Same animal on the following morning. Œdematous swellings and pendulous, swollen ears.

Tying off the fistula tube so that a condition equivalent to simple ligation of the duct ensued, again led to marked photosensitivity.

We have now had an opportunity of comparing these findings with samples of bile, serum, etc., taken from actual geel-dikkop cases in two different outbreaks. From every serum examined, the same porphyrin-like pigment was isolated and this in no way differed from that found in the experimental obstruction cases. Further, the biles of the sick animals in each instance contained large amounts of the same pigment, ranging from four to fifteen times the normal bile concentration. The identity of the porphyrin-like pigment in the experimental and geel-

dikkop cases has been established with certainty by means of comparing absorption spectra, crystalline forms from different solvents and its conversion into the same methyl-ester by esterification (Fig. 1).

With larger quantities of pigment derived from the working up of dried fistula bile we have now been able to recognise the pigment as the chlorophyll derivative, phylloerythrin, a true porphyrin as shown by Fischer *et al.*[3], and first discovered in bile by Löbisch and Fischler[4].

The identification of the pigment was based upon elementary analysis, absorption spectra in acid and in ethereal solutions and elementary analysis and melting point of its methyl ester.

Marchlewski[5] showed that the excretion of phylloerythrin was related to the amount of chlorophyll in the diet. We are at present investigating the factors responsible for its formation.

Phylloerythrin has not, so far, been recognised as a photosensitising substance. That it *is* photoactive we have proved by injecting 0·1 gm. intravenously into an unpigmented merino sheep. Within about thirty minutes, the animal became intensely sensitive, crouching in an endeavour to avoid the sun's rays, flinching, shaking the head and ears and finally lying down in a peculiarly contorted position (Fig. 2). Swellings of the lips and ears were soon noticeable and the next day a large pouch of œdematous fluid distended the loose skin in the intermandibular space (Fig. 3). Smaller quantities injected into white mice, subcutaneously, killed these animals within half an hour when exposed to the sun's light. An identical result was obtained using a specimen of phylloerythrin prepared from chlorophyll by chemical means. The final proof is therefore obtained that the photosensitivity which characterises the disease 'tribulosis' or 'geel-dikkop' is due to the passage into the blood-stream of the plant porphyrin, phylloerythrin, derived ultimately from ingested chlorophyll and, for some reason or other, present in the bile of these cases in abnormally large quantities.

Of course, the reason for the icterus in geel-dikkop is still being sought. It would appear that affected animals suffer from an insufficiency of the liver, whereby biliary secretion fails and icterus consequently develops; there is no demonstrable obstruction of the bile ducts. A further possibility, which we have not lost sight of, is the hypothetical production of bilirubinoid substances from pigments of plant origin.

The finding that a chlorophyll derivative is the cause of photosensitivity in geel-dikkop explains why not only *Tribulus* but also other plants can cause the disease. No light is yet thrown, however, upon the peculiarly erratic nature of its appearances, and we still incline to the view that the physiological factors are here of paramount importance. The production of porphyrins by the action of micro-organisms upon chlorophyll is being investigated. These results together with full details of the above findings will be published shortly.

[1] Quin and Rimington, NATURE, **130**, 926, Dec. 17, 1932.
[2] Quin, forthcoming publication. Nineteenth Report of the Director of Veterinary Services, Union of South Africa.
[3] Fischer, Moldenhauer and Süs, *Liebigs Ann.*, **485**, 1; 1931.
[4] Löbisch and Fischler, *Monatsheft. Chem.*, **24**, 335; 1904.
[5] Marchlewski, *Z. Physiol. Chem.*, **43**, 208; 1904-5.

Electrical Interference and Broadcasting

THE modern widespread use of broadcasting receivers of continually increasing sensitivity has made most listeners familiar with the interference which arises from the operation of various types of machinery and apparatus from the electric supply mains. It may not be generally known how much the listening public is indebted to the experts of the Post Office for doing whatever lies in their power to prevent or cure interference of this kind.

At last year's Radio Exhibition at Olympia, a very interesting demonstration was given of the manner in which the interfering noises on a wireless receiver, which arise from the operation of electric fans, vacuum cleaners, refrigerators and flashing signs, may be eliminated by the connexion of a suitable choke-condenser by-pass arrangement to the machine or apparatus causing the disturbance. More recently the Institution of Post Office Electrical Engineers has published a paper by Col. A. S. Angwin containing an account of what has been accomplished in combating this 'man-made' interference.

This paper states that the Post Office organisation is dealing with cases of electrical interference at the rate of some ten thousand a year and the information resulting therefrom is centralised in the Radio Section of the Engineer-in-Chief's office in London. All complaints reach that office after investigations have been made, and there has been in consequence a gradual accumulation of knowledge of the various types of interference and the means found most suitable for minimising it.

The interference associated with supply mains and with electrical machinery and apparatus can be classified into two main groups, comprising radio and audio-frequency disturbances respectively. Col. Angwin's paper states that most of the interference belongs to the first group, and is attributable to sudden changes in current in the electrical circuits, such as may be caused by switch gear, commutators, faulty contacts, etc. By connecting suitable by-pass arrangements in the manner referred to above, the high frequency transients resulting from these effects are restricted to small areas of the mains as remote as possible from the receiver affected.

There would appear to be some reason for adopting the suggestion put forward recently in the *Wireless World*, that the responsibility for fitting these interference-preventing devices should rest with the manufacturers of the electrical machinery and appliances. Medical high-frequency apparatus is particularly difficult to deal with; it appears that operation inside screened enclosures is the only satisfactory solution. In the case of electric tramways, and particularly trolley buses with an overhead wire supply, a remedy was found in the fitting of special chokes in the trolley arms. These chokes are constructed to have a high impedance at the frequency of the broadcasting transmitter serving the area concerned, and in many cases this remedy has proved very successful indeed.

With the increased use of short and ultra-short waves for broadcasting and television purposes, a further type of interference is experienced. This arises from the ignition systems of internal combustion engines, which are capable of setting up direct radiation on very short wave-lengths. This trouble has already been encountered in acute form in aeroplanes equipped with wireless, and it appears that

complete metallic screening of the whole ignition system is the only really effective remedy.

From this brief survey it will be evident that the problems of electrical interference with broadcast and general wireless reception are being very effectively handled by expert engineers of the Post Office, and that a steady reduction of this trouble is likely to take place as general application is made of the principles which have already been evolved.

Genetics Research at Cold Spring Harbor

THE Year Book of the Carnegie Institution of Washington (No. 31) includes a report on the work of the Department of Genetics at Cold Spring Harbor. Investigations have been continued mainly with *Datura* and *Delphinium*, *Drosophila* and *Sciara*, Daphnidæ, pigeons, mice and man. Increased liaison between genetics and other fields, such as embryology, physiology and pathology, is in evidence.

The γ-gene for miniature wing in *Drosophila virilis* arises as a mutation only in somatic cells. It is sex-linked and unstable. Four modifying genes have now been found which increase its instability and are located in different chromosomes. Ten new mutations have been found in this species.

In *Datura*, the collection of about 550 introduced races from many parts of the world by Blakeslee has led to the recognition of more than 160 characters, many of which have been shown to be due to single genes. Five different kinds of male-sterile mutants have appeared, one of which is dominant and is located in the 9·10 chromosome. One male-sterile plant produced a tetraploid mutation. Eight types with rough or glaucous leaves have been found, one of which is dominant and is linked with a chromosome complex due to translocation between chromosomes 1·2 and 11·12. Among pollen mutations is a type from Hungary with twinning of meiotic chromosomes, leading to giant pollen grains with so many as 96 chromosomes. Another type is asynaptic, and in yet another the pollen grains are starchless. Of prime types, that is, with interchanged or translocated chromosomes, 57 have been found, in 33 of which the modified chromosomes have been determined. Several pure-breeding types have been synthesised which are homozygous for a condition in which a fragment of one chromosome is attached to another. Two of these have 26 chromosomes. Other evidence shows that segmental interchange is of widespread occurrence in *Datura* species.

In pigeons a third hormone from the anterior pituitary, called prolactin, has been isolated by Riddle and his associates. It is the special agent which induces crop-gland formation. Injected into non-pregnant guinea pigs and rabbits, it induces lactation in them in three to five days. It is also found that female pigeons have larger anterior pituitary and longer intestines than males. Cytological studies of leukemia in mice have led to its classification as a form of cancer. Inheritance of spontaneous leukemia is being studied by MacDowell.

As regards man, the investigations include genetical studies of otosclerosis and differences in sensory thresholds, especially bitter tastes and the odours of various flowers. Studies of growth-rates, metabolism and racial differences among whites, Maya Indians and Negroes are also recorded, and Steggerda has plotted the distribution of mutations among the Indians in North America. R. R. G.

University and Educational Intelligence

EDINBURGH.—The University Court has approved of an arrangement for an exchange of duties for the session 1933–34 between Dr. Neil Campbell, lecturer in organic chemistry, and Dr. L. A. Bigelow, assistant professor of organic chemistry in Duke University, North Carolina.

Dr. E. G. V. Percival has been appointed lecturer in the Department of Chemistry.

Leave has been granted to Prof. E. P. Stebbing, professor of forestry, for the spring term of 1934, to enable him to visit West African forests, and to Mr. H. S. Ruse, lecturer in mathematics, for 1933–34, in order that he may accept a Rockefeller fellowship in mathematics at Princeton University.

LONDON.—Dr. R. A. Webb, since 1929 University lecturer in pathology at Cambridge, has been appointed University professor of pathology (London School of Medicine for Women).

The Sir George Jessel studentship in mathematics for 1933 has been awarded to Mr. L. W. F. Elen, of University College.

ST. ANDREWS.—Dr. O. A. Oeser, of Dartington Hall, Totnes, has been appointed to the lectureship in experimental psychology vacant by the retirement of Mr. C. A. Mace on his appointment to a post in Bedford College, London.

WALES.—The fiftieth anniversary of the opening of the University College of South Wales and Monmouthshire, which falls this year, has been celebrated in a number of ways during the past session. A history of the College has been written by Prof. A. H. Trow, the former principal, and Mr. D. J. A. Brown, the registrar. At the degree congregation of the University of Wales held on July 20, honorary degrees were conferred on a small number of individuals who have rendered conspicuous service to the College. This was followed by a reception in the evening at which Lord Treowen, the president of the College, received some 2,000 guests. Congratulatory addresses were presented by the representatives of 22 British and Irish institutions of university rank.

Prof. A. A. Read is retiring at the end of the session after forty years in the service of the College, and the Council has appointed Dr. W. R. D. Jones, lecturer in metallurgy, to succeed him as professor of metallurgy and fuel technology.

THE programme of cinematograph films to be shown during August by the Empire Marketing Board at its cinema at the Imperial Institute has recently been published. Many interesting titles are included among the films, which are chiefly of geographical, industrial, agricultural and biological interest. The programme, which also contains details of times of sessions, etc., can be obtained from the Secretary of the Imperial Institute, South Kensington, London, S.W.7.

THE Carnegie Trust for the Universities of Scotland has been in operation since 1901, when it was endowed by its founder with a capital of £2,000,000. In its

thirty-first annual report, the executive committee, reviewing the trustees' stewardship since its inception, describes how by judicious management during and since the War, the capital has been increased to three and a half millions sterling. In the academic year 1931–32, the grants to universities and extra-mural institutions (chiefly technical, agricultural and medical colleges and the Rowett Research Institute) amounted to £52,000, distributed between libraries (£6,000), buildings and permanent equipment (£37,000) and the endowment of teaching and other general purposes (£9,000). Awards of fellowships, scholarships and grants for research absorbed £17,000. Assistance in payment of class fees of 4,389 students amounted to £57,620. Inquiry into the financial circumstances of applicants for assistance disclosed 710 specially necessitous cases in which full payment of class fees was granted. To secure that Trust assistance should be restricted to students who have shown an aptitude for taking full advantage of their opportunities, the standard of educational qualification was recently raised, but only five per cent of applicants for 1932–33 had not reached the new standard. Spontaneous repayments by former beneficiaries of class fees paid for them by the Trust amounted to £1,698. The aggregate amount of such repayments up to date from 1901 is £30,773, distributed as follows: medicine £13,350, arts £11,452, science £5,358, other faculties £613.

Calendar of Nature Topics

Commerce and Ducks

With the close of the nesting season, the legal restrictions upon the slaughter of birds slackens, and commerce (as well as the sportsman) begins to survey the prospects. On July 27 the close season for ducks comes to an end in Holland and between that date and February 14 great destruction takes place. It is said that there are 145 duck decoy-ponds in Holland alone and that their average annual catch, which supplies an extensive and profitable canning industry, is 300,000 ducks. In Germany there are eleven decoys with a catch of 40,000, and two Danish ponds contribute a further 12,000. The English catch is insignificant, at about 600 a year. The ducks killed in these countries are by no means wholly the product of the countries; indeed the majority of the ducks killed in Holland appear to come from Scandinavia and Finland.

Migration, therefore, brings about the curious situation that the country which breeds the birds can have practically no share in the duck harvest, since legal restrictions cover the breeding season; while countries which have no responsibility for duck protection reap the harvest. The northern countries allege that there has been a serious falling off in the number of their breeding ducks, owing to the slaughter which takes place in the winter haunts, over which they have no control.

Here clearly is opportunity for international arrangement, for any serious reduction of the breeding population in the north will redound adversely upon the commercial catch in the south. The suggestion was made at the International Ornithological Conference of 1932 that a tentative effort to right the situation might be made by curtailing the open season so that it lasts only from September 15 to January 31.

Increase of Woodcock in Great Britain

With the end of the legal close season, which in general protects all birds in Britain from March 1 until August 1, quail and woodcock shooting begins. As natives of Britain the two birds stand in contrast, for while quail are less abundant than they used to be (see NATURE Calendar, March 4, p. 337), woodcock have increased enormously. In 1770 Gilbert White wrote: "it cannot be denied, but that now and then we hear of a woodcock's nest, or young birds, discovered in some part or other of this island; but then they are always mentioned as rarities, and somewhat out of the common course of things"; and two years later Pennant stated that there was no account of these birds breeding in Scotland.

Since then a remarkable increase has taken place, and the woodcock is to be found breeding throughout Britain, in some districts in considerable numbers. Two changes have contributed to the increase: the growth of many plantations of trees since the beginning of the nineteenth century affords suitable nesting sites, and the protection of the birds during the close season has enabled them to multiply in safety. The value of protection is well illustrated by the change it has brought about in the shooting of woodcock. Sir Herbert Maxwell has recorded that in his young days the Easter holidays were looked upon as the best season for shooting woodcock, the belief being that the birds which at that time collected upon the coast had gathered in preparation for the spring emigration to northern countries. But these flocks were really immigrants, most of which prepared to nest in Great Britain. The institution of a close season beginning on March 1 saved these birds as breeding stock, and the remarkable increase since is in great part the compound interest of the capital so saved.

Breeding Season of the Grey Squirrel

With the passing of July the breeding season of the grey squirrel (*Sciurus carolinensis*) in Britain draws to a close. In the native haunts of the species, in the eastern states of the United States, the first young appear in March and two litters are often raised in a year, and in Britain, Ruth Deanesly and A. S. Parkes found (out of a relatively small number of individuals) pregnant females even in January and February, while the monthly numbers of pregnancies, reaching two apices, in March and June, suggest that here also the grey squirrel may be double brooded (*Phil. Trans. Roy. Soc., London*, B, 222, 47; 1933). In the United States the young number four to six in a litter; in Britain the average size of a litter, judging by the number of fœtuses and nest young, appears to average 3·6. The annual reproductive cycle differs in the two sexes, for while the females have a definite period of anœstrus lasting through autumn and early winter, when the reproductive organs are atrophic, in the males spermatogenesis continues actively throughout the year, having no quiescent period such as occurs in mammals like the ferret. Female grey squirrels begin to breed when rather less than a year old, and although neither the period of gestation nor the duration of lactation has been determined, the combined periods, approximately represented by the interval between two litters, is about three months.

Hot Summers and the Spread of Duckweed

The commonest British duckweed (*Lemna minor*, L.)—a favourite haunt of *Hydra*—produces its tiny

flowers in July. Very hot summers are favourable to the increase of the rarer *L. gibba*, L., which has been shown to require a higher temperature than *L. minor* for both flowering and budding. The remarkable spread of this species, under appropriate conditions, may be judged from Hegelmaier's case of a piece of water about half an acre in extent which was found during hot summer weather to have a border a few feet wide of fronds of *L. gibba*. Vegetative growth took place with such rapidity that nineteen days later nearly the whole surface was thickly covered.

Summer Rains and the Distribution of Organisms

The low water conditions due to summer drought coincide in July with the maximum growth of aquatic vegetation generally, with the result that in many rivers the dwindled stream becomes greatly impeded by masses of plants, among which the aquatic species of *Ranunculus* are prominent. In heterophyllous species which reach to and grow thickly at the surface, a semi-solid obstruction is formed, round the margin of which there is constant attrition of floating leaves and flowers by the current. Fragments thus removed are probably of consequence in the spreading of the plants concerned, as well as in the distribution of small attached invertebrates, at a time of year when temperature facilitates establishment in new sites. Sudden flushing of the river in consequence of a summer thunderstorm or sudden heavy rainfall results in greatly increased damage to the aquatic flora, and a coarse meshed net hung in the current at such a time will readily become choked with pieces of water plants. In *Ranunculus fluitans*, the flowers of which are not carried well above the surface, a very slight inundation may result in failure to set seed. In shallow rivers suddenly subjected to flood water, marked shifting of the bottom may occur and mosses and other lesser plants suffer in the general disturbance. So also may be influenced the distribution of the egg masses of various aquatic insects. A definite relation has been noted between vegetation and the abundance of some species. Perceval and Whitehead studying *Ephemerella ignita* found 200 per sq. dec. in moss, and 30–60 per sq. dec. among filamentous algæ (*Cladophora*, etc.). The eggs of *E. ignita* on extrusion are bound by a stiff substance which absorbs water and cements the falling eggs to underwater plants and other objects. Egg masses thus attached have been found in numbers among river flotsam.

Verañillo

In the equatorial regions of the Amazon and Congo valleys, the year is divided into two wet and two dry seasons almost equally spaced. Proceeding northward from the equator, the first rainy season comes somewhat later and the second rainy season somewhat earlier, until they combine as the single rainy season of the northern summer, generally termed a 'monsoon'. In many places, however, this rainy season is partly interrupted by a somewhat drier period towards the end of July. On the Atlantic coast of Mexico and in Central America, this break lasts for two or three weeks and is known as the Verañillo or 'little dry period', in contrast to the Verano or main dry period. It is never rainless, but affords some relief from the torrential downpours of June, which recur in August and September. The long dry season or Verano usually commences towards the end of November, and is practically rainless in many places.

Societies and Academies

LONDON

Physical Society, July 7. F. TWYMAN and G. F. LOTHIAN: Conditions for securing accuracy in spectrophotometry. The first section deals with absorption spectrophotometry in application to chemistry and includes consideration of the various methods in use, namely, photographic, visual and photoelectric, the optimum conditions for each method being stated; and the three types of method are compared. The second section is concerned with spectrophotometry as a means of describing a radiation, for example in connexion with colorimetry, the comparison of light-sources, and quantitative spectrum analysis. W. E. WILLIAMS: Studies in interferometry (2). The construction, testing and use of reflection echelons for the visible and ultra-violet regions. The various methods of mounting are compared. A method is described whereby the instrument can be used for wave-length measurements. It is further shown that the echelon provides an alternative means of standardising length units in terms of a wave-length of light. E. V. APPLETON: Two methods of ionospheric investigation. Both methods involve measurements of the equivalent height of reflection for a number of electric wave frequencies. Different relations are expected and found to exist between the equivalent height and the frequency for the ordinary and extra-ordinary magneto-ionic components. It is found that magneto-ionic double refraction is caused by region *E*. For daytime conditions, and more frequently in summer than in winter, evidence of the existence of a protuberance or ledge on region *F* is found. Evidence of the existence of ionisation between regions *E* and *F* ('intermediate region') has also occasionally been obtained at noon, so that the whole ionospheric configuration may be regarded as a composite structure of four components, regions E^I, E^{II}, F^I and F^{II}. Usually only regions E^I and F^{II} are of importance (see NATURE, June 17, p. 872). A. H. JAY: A high-temperature X-ray camera for precision measurements. A high-temperature X-ray camera has been designed for taking powder photographs which show well-resolved K_α doublets at high angles of reflection, enabling an accurate estimate of line position to be made. The temperature of the specimen was found in the following way. Photographs of silver, from which the lattice dimensions were calculated, were taken with varying heating-currents. The coefficient of expansion of silver was used to convert lattice-spacing measurements to degrees centigrade. A curve relating the watts in the furnaces to the temperature of the specimens was thus obtained. A. ELLIOTT: The intensities of bands in the spectrum of boron monoxide. The intensities of the α bands of boron monoxide have been measured by means of an arrangement which gives the intensity of a whole band. Precautions for the detection of systematic errors are described, and the probable error is estimated at about ± 5 per cent. The intensity ratio of the $B^{11}O$ and $B^{10}O$ bands has been measured for two of the α bands. The result, 3·5 : 1, is in satisfactory agreement with a previous determination of the isotope intensity ratio in the β bands of boron monoxide, 3·66 : 1. J. F. HEARD: Pressure effects in the spectra Xe I and Xe II. The first and second spectra of xenon have been examined for pressure effects. At high

pressure, lines of the Xe I spectrum show broadenings which correspond qualitatively to their respective Stark effects. This points to the existence of strong interionic electric fields within the discharge. Many pressure displacements in the Xe II spectrum are also found, and it is suggested that these too have their origin in interionic fields. E. GWYNNE JONES : Hyperfine structure in the spark spectrum of cadmium. The Cd II spectrum has been investigated in the region λλ4200–8500 with Fabry-Perot etalons. Of the 13 lines examined, only λ8067 has any structure. From the structure of the $6^2S_{\frac{1}{2}}$ term it is calculated that the $g(I)$ factor of the odd isotopes is $-1{\cdot}25$ proton magnetons.

LEEDS

Philosophical and Literary Society, June 21. R. WHIDDINGTON and J. E. TAYLOR : Preliminary note on the probability of certain electron excitations in helium, argon and neon. Experiments on the excitation of argon and neon by electrons of energy between 60 and 350 volts have been carried out. The variation of the probability of excitation of the (3^1S-4^1P) level in argon is almost linear over the range considered. This is a similar result to that obtained with the (1^1S-2^1P) singlet transition in helium. The curve obtained for the combined excitations 2^1S-3^1P, and $2^1S-3^3P_2$ (unresolved) for neon show a marked hump at an electron voltage of 160 volts. This is in agreement with recent theory on the variation of probability of a triplet excitation with voltage. G. W. BRINDLEY : Energy losses of slow electrons in nitrogen. The method developed by Whiddington and others for measuring the energy losses of electrons in gases, has been applied to the case of nitrogen. The chief losses are 8·6 volts, 12·25 volts, 12·9 volts and 14·9 volts, the second and third losses being much the most probable. These results agree with the spectroscopic singlet levels, '*a*' (8·50), '*b*' (12·52) and *b* and *c* (12·79 and 12·88). The 14·9 volts loss agrees with the *D* triplet level if Sponer's value of 13 volts is assumed for the *C* triplet level. These results do not agree with results given by Rudberg for nitrogen using a similar method. N. F. BARBER : Note on the shape of an electron beam bent in a magnetic field. Cross-sections of a conical beam bent in a magnetic field are considered with particular reference to the experimental investigation of the velocity distribution in an electron diffraction cone. A general formula for the shape of the sections for any angular deviation is deduced, and it is shown that it is elliptical to the first order, distorted by second order terms which are negligible with the small diffraction angles usually involved. The points at which the ellipses degenerate to a line are considered and shown to obey a simple rule, of which the usual 180° focusing in a magnetic field is a special case. The arrangement of an apparatus for maximum sensitivity in detecting a velocity difference in the cone is considered. H. M. DAWSON and W. LOWSON : The induction period in the production of glycollic acid by the hydrolysis of halogen-substituted acetates. In the early stages of the hydrolysis in fairly concentrated solutions of the alkali salts, it is found that the halogen is eliminated at constant speed whilst the rate of formation of glycollic acid increases continuously until it becomes identical with the rate of formation of halide. A method for the evaluation of the induction period is described and experiments with solutions of sodium chloroacetate at 25° show that this is approximately equal to 3,000 minutes. J. H. ELLIOTT : Growth and differentiation in the vascular system during leaf development in the dicotyledon. In the leaf of *Acer Pseudoplatanus*, cambial activity recommences at the junction of petiole and lamina and proceeds basipetally down the petiole and acropetally along the main vein. In *Castanea vulgaris* cambial activity recommences at the base of the petiole and proceeds acropetally along both petiole and lamina. In both leaves xylem is produced only while the leaf is extending. In *Acer* secondary phloem is produced only subsequent to the cessation of extension, but in *Castanea* it is produced throughout the life of the leaf. J. A. MOY-THOMAS : Notes on carboniferous fishes in the Leeds City Museum. (1) Sharks. This paper is the first of a series figuring and redescribing Dr. Wellburn's type specimens of fossil fish recently purchased for the Leeds City Museum. It includes figures and additional description of *Petalodus ornatus*, W., *Janassa sulcata*, W., *Psephodus minutus*, W., and *Euctenodopsis tenuis*, W. *J. sulcata* is shown to be probably only another form of *J. linguæformis*, Atthey, from which it is scarcely satisfactorily distinguished. E. L. E. WHEATCROFT : Measurements of the maintenance potential of a glow discharge in air. Measurements made with a glow discharge tube having plane electrodes, when the spacing is so reduced as to contract the Crookes's dark space, show that the potential needed to maintain a current differs very little from the striking potential. Both potentials are functions of pressure and spacing, if a small empirical correction be made for conduction to the edges of the elctrodes.

PARIS

Academy of Sciences, June 12 (*C.R.*, 196, 1753–1840). HENRY LE CHATELIER : The law of displacement of chemical equilibrium. CHARLES ACHARD, AUGUSTIN BOUTARIC and JEAN BOUCHARD : The antioxygen properties of certain alkaloids. All the alkaloids studied clearly reduced the fluorescent power of uranine both in aqueous and alcoholic solutions. HENRY FAIRFIELD OSBORN : The principles which have governed the biomechanical evolution of the mammals. K. L. HIONG : Meromorph functions in the unity circle. G. BOULIGAND : The general properties of multiform correspondences. E. BLANC : The structure of certain general laws governing multiform correspondences. MLLE. MARIE CHARPENTIER : The semi-continuity of inclusion of the trajectories of dynamics. A. LIÉNARD : Formulæ of recurrence for the integrals of attached functions of Legendre polynomials. RAPHAEL SALEM : The extremal properties of certain trigonometric polynomials. LEROUX : Comparison of dynamical Pitot tubes. MME. E. CHANDON, R. DE VOLONTAT and A. GOUGENHEIM : Apparatus for the measurement of the absolute personal equation in observations with the prism astrolabe. Three types of apparatus are described and the personal equation of three observers with each type given. EMILE SEVIN : The contraction of the universe. E. BANDERET : Liesegang rings obtained by electrolysis. When a current is passed through a layer of gelatine containing potassium bichromate, using silver electrodes, bands exactly resembling Liesegang rings are formed from the anode. The bands are finer than rings obtained by the drop of silver nitrate method. JEAN ROULLEAU : An amplifying voltmeter. In the valve amplifier described, a variation of 20 microvolts produces a

variation of 0·04 milliampere in the milliammeter circuit. The main advantage of the arrangement is its stability. LÉON and EUGÈNE BLOCH: The structure of the principal Raman line of benzene. The results given agree well with those of Howlett but not with those of Grassmann. M. HAÏSSINSKY: The separation of the elements 88(Ra), 89(Ac), and 90(Th) with the aid of organic solvents. The method of separation is based on the facts that thorium-X nitrate is insoluble in absolute ethyl alcohol whilst meso-thorium-2 nitrate, the isotope of actinium, is easily soluble in this solvent, as is also thorium nitrate. On adding pyridine to the alcoholic solution of the two latter salts, thorium alone is precipitated. G. GUÉBEN and L. HERMANS: The phenomena of passage produced by the γ-rays. Hoffmann, Steinke and Schindler found the ionisation effects produced by ultra-radiation varied after interposition of equivalent metallic layers. Exactly similar effects have been found by the authors with the γ-rays, and Workman has recently obtained the same results. The authors give reasons for not accepting Millikan's view of the electromagnetic nature of the ultra-radiation and consider that the observed results are due to the action of secondary corpuscular rays set free in the interposed screens. LA. GOLDSTEIN: Atoms of recoil in gaseous media. Electronic affinity. W. BRONIEWSKI and J. SMOLINSKI: The structure of the iron-nickel alloys. Admitting the existence of the combination $FeNi_2$, the structure of the iron-nickel alloys allows of the following interpretation: up to 28 per cent nickel, solid solution of $FeNi_2$ in iron: 28–32 per cent of nickel, mixture of two limit solid solutions: 32–67·8 per cent nickel, solid solution of iron in $FeNi_2$: 67·8–100 per cent nickel, continuous solid solution of nickel and $FeNi_2$. PAUL BARY and EMILE FLEURENT: The limit of degradation of solutions of india-rubber. PAUL BAUD: John Holker and the manufacture of sulphuric acid in France in the eighteenth century. The first French manufacture of oil of vitriol was due to the efforts of John Holker and his son, but was not commenced until 1769. HARNIST: The transformation under pressure of thionates and ammonium thiocyanate into sulphate and sulphur. A. TRAVERS and BAUER: The change of constitution of tricalcium phosphate after fusion. MME. RAMART-LUCAS and MLLE. WOHL: The comparative solubility of isomers according to their absorption spectra. The isomerisation of the arylamines. P. CARRÉ: The mobilities of the alkyl radicals in their chlorosulphites. L. DEBUCQUET and L. VELLUZ: Some new combinations of hexamethylenetetramine. The compounds with chromates, bichromates, ferricyanides and ferrocyanides described may have applications in micro-analysis. NILS STENDAL: The characterisation of the higher fatty acids in the form of mono-ureides. PIERRE SÜE and GEORGES WÉTROFF: The alkaline salts of orthoxyquinoline. MLLE. R. MENDES DA COSTA: The absorption in the ultra-violet of some β-arylacrylic acids and their derivatives. B. BRAJNIKOV: The first results of a study on the surface alteration of chalk. The mechanism of the alteration. G. MISTARDIS: The quaternary grits of Attica. ALBERT DE LAPPARENT: The [geology of the] neighbourhood of Ampus (Var). CARL STÖRMER: Clouds in the stratosphere. H. COLIN and H. BELVAL: Raffinose in cereals. ANTONIO SOSA: A new heteroside from *Betula alba*. A. CH. HOLLANDE: The cytological structure of *Bacillus enterothrix camptospora* and of *Bacillospira* (*Spirillum*) *præclarum*. PAUL WINTREBERT: The slow determination, at the time of gastrulation, of the organising centre of amphibians, demonstrated in *Discoglossus* by the experimental ascent of the dorsal rim. A. MAGNAN, A. SAINTE-LAGUË and CL. MAGNAN: Contribution to the study of the mechanism of flight in insects. CH. JOYEUX and JEAN G. BAER: The evolutive cycle of a tapeworm from the snake.

Official Publications Received

GREAT BRITAIN AND IRELAND

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 8, No. 3, July. Pp. 241–344. (London: Cambridge University Press.) 12*s.* 6*d.* net.

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge for the Academical Year 1931–1932. (Published by Authority.) Pp. 119. (Cambridge: Printed at the University Press.)

Research Work in Slavonic Countries, Academic Year 1932–33. 1: Czechoslovakia. Pp. ii+37. 2: Poland. Pp. ii+32. (Birmingham: The University.)

British Empire Cancer Campaign. Tenth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 10th July 1933. Pp. 253. (London.)

Transactions and Proceedings of the South London Entomological and Natural History Society, 1932–33. Pp. xx+137. (London.) 12*s.*

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 38: Report of the Irish Radium Committee for the Year 1932; including Reports by Oliver Chance, Oswald J. Murphy and John A. Geraghty. Pp. 551–562. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.*

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 2, No. 13: The Formation of Rock Joints and the Cleat of Coal. By Prof. P. F. Kendall and Prof. Henry Briggs. Pp. 164–187. 2*s.* 6*d.* Vol. 53, Part 2, No. 14: Studies in Genetical Psychology; The Intellectual Resemblance of Collateral Relatives. By J. L. Gray and Pearl Moshinsky. Pp. 188–207. 2*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

OTHER COUNTRIES

Territory of New Guinea: Department of Agriculture. Entomological Bulletin No. 1: Coconut Pests. By John L. Froggatt. (Leaflet No. 67.) Pp. 9+4 plates. Leaflet No. 68: Price List of Planting Material obtainable from the Department of Agriculture, Rabaul. Pp. 11. Leaflet No. 69: Notes on the "Coconut" Grass Hopper or Long Horned Tree Hopper (Sexava sp.). Pp. 4. (Sydney: Government Printer.)

U.S. Department of Agriculture. Circular No. 280: Contact Sprays for the Japanese Beetle. By Walter E. Fleming. Pp. 4. 5 cents. Technical Bulletin No. 361: The Hessian Fly in the Pacific Northwest. By L. P. Rockwood and Max M. Reeher. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.)

Canada: Department of Mines; Mines Branch. Investigations in Ceramics and Road Materials (Testing and Research Laboratories) 1930 and 1931. (No. 726.) Pp. ii+175. (Ottawa: F. A. Acland.)

Tanganyika Territory: Geological Survey Department. Bulletin No. 6: Provisional Geological Map of Tanganyika, with Explanatory Notes on the Geological Formations and Mineral Occurrences and Chronological Table (provisional) of the Former. By Dr. E. O. Teale. Pp. ii+34. (Dar es Salaam: Government Printer.) 4*s.*

Tanganyika Territory: Department of Agriculture. Annual Report, 1932. Pp. ii+104. (Dar es Salaam: Government Printer.) 2*s.* 6*d.*

Report of the Kodaikanal Observatory for the Year 1932. Pp. 5. (Delhi: Manager of Publications.) 2 annas; 3*d.*

Journal of the Faculty of Engineering, Tokyo Imperial University. Vol. 20, No. 8, June: On the Elastic Stability of Aeroplane Structures. By Masao Yamana. Pp. 163–224. (Tokyo: Maruzen Co., Ltd.)

Japanese Journal of Botany. Transactions and Abstracts, Vol. 6, No. 3. Pp. vi+307–487+63—93+plates 12–20. (Tokyo: National Research Council of Japan.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 22. (New York City.)

Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1931. Pp. iv+186. (Zinsen: Meteorological Observatory.)

The Indian Forest Records. Vol. 17, Part 7: Interim Report on Work under Project No. 2, Strength Tests of Timbers in Structural Sizes, with Test Results up to 1932. By L. N. Seaman. Pp. iii+39+2 plates. 1 rupee; 1*s.* 9*d.* Vol. 17, Part 8: Immature Stages of Indian Coleoptera, 12: Carabidæ, contd. By J. C. M. Gardner. Pp. ii+12+2 plates. 9 annas; 1*s.* (Delhi: Manager of Publications.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 12, 1930. iv. Meteorologiska iakttagelser i Sverige. Pp. x+177. (Stockholm.) 7.00 kr.

CATALOGUES

Catalogue of Books and Journals bearing on Agriculture and Botany. (No. 414.) Pp. 48. (Cambridge: W. Heffer and Sons, Ltd.)

A Collection of Modern Books in all Classes of Literature offered at greatly Reduced Prices. (No. 476.) Pp. 48. (London: Bernard Quaritch, Ltd.)

Selected List of Publishers' Remainders, being New Books on various Subjects offered at greatly Reduced Prices. (Catalogue No. 561.) Pp. 22. A General Catalogue of Books on many Subjects, with a Selection of Atlases and Maps. (Catalogue No. 562.) Pp. 80. (London: Francis Edwards, Ltd.)