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Organisation of Radio Research in India

IT is a well-established axiom to-day that progress in all branches of scientific knowledge can only be maintained by the conduct of intensive fundamental research, as well as by the continued developments in the application of the particular field of science under consideration. In many fields this type of research can be carried out within the confines of the ordinary scientific laboratory. Research into the fundamental problems of radio communication, however, can scarcely be limited in this way, since many of the investigations require to be conducted in a laboratory of world-wide dimensions, and considerable resources and much co-operation are necessary in order to stage the experimental work on an adequate basis. Such considerations as these have led to the establishment of national radio research boards, the first of which was formed in Great Britain in 1920, while others have followed in Australia and Canada. The time would now appear to be very opportune for considering the establishment of a similar Radio Research Board in India, where fundamental research in radio communication has so far been limited to the activities of quite small bands of workers in different universities, notably those under Prof. S. K. Mitra at Calcutta and under Prof. M. N. Saha at Allahabad.

To those interested in the general progress of radio communication, whether from a scientific or commercial point of view, there would appear to be a strong case for the establishment of such a research organisation. The tropical climatic conditions of India are likely to have a considerable influence upon the production, propagation and reception of the electric waves used in radio communication, and the effects to be expected are not easily predictable from the knowledge that has been gained from research conducted under the more equable conditions of Great Britain. The phenomena of the propagation of waves along the ground and through the atmosphere can only be investigated adequately on the spot, while the proximity of India to the seat of intense atmospheric disturbances will have a considerable influence on wireless reception.

Many of these problems are of interest for their own sake; they will most certainly be of great interest to those who have already gained considerable knowledge from similar work under other radio research organisations; but in addition to this, the knowledge gained from the successful attack on these problems will be of the greatest importance to those responsible for the development of radio communication in India, for broadcasting and other purposes. In some ways, the development of radio stations for ordinary telegraphic and telephonic purposes in India has been carried to a moderately satisfactory stage, largely due to the very active assistance rendered by the appropriate administrations in Great Britain. Even in this sphere, however, it must not be considered that progress and development are by any means complete.

It is in the field of broadcasting, however, that noteworthy developments appear to be likely. The population of India is in the order of 350 millions, of whom it is estimated that only about 12,000 are registered broadcast listeners. With the full realisation that a large proportion of broadcast listening among the masses is likely to be on a communal basis, it is perhaps not an overestimate to suggest that the number of potential

purchasers of broadcast receivers is of the order of three and a half millions. There is an attractive market to the manufacturer of receivers, which must naturally be adapted to the conditions, climatic and other, under which they would be required to function in India.

Before consideration can usefully be given to this aspect, however, it is necessary that a radio broadcasting service shall be provided in India on an adequate scale, and Mr. K. Sreenivasan, of the Indian Institute of Science, Bangalore, has already described in some detail the type of organisation which is required for this purpose (see NATURE, Aug. 10, 1935, p. 231). Such a broadcasting organisation would derive considerable benefit from the establishment of a Radio Research Board, with which it could co-operate in the conduct of many of the fundamental problems underlying its technical service. Indeed, in so far as the British Broadcasting Corporation is already providing a part of its Empire service for English-speaking residents in India, a local organisation which could investigate and give advice upon the problems of reception in India would most certainly be welcomed by the broadcasting authorities in Great Britain.

The benefits to be derived from a new organisation of the type under discussion are most clearly appreciated from a brief review of the work of those radio research boards already in operation.

In Great Britain, the Radio Research Board was established in 1920 under the Department of Scientific and Industrial Research. It comprises representatives of all Government departments interested in radio communication, namely, the defence services, the Post Office and the British Broadcasting Corporation, and in addition, there are one or two university members who have attained high standing in radio research. The research work is conducted largely at the National Physical Laboratory, but in part also at universities under the general supervision of a number of technical committees appointed by the Board. The programme of research for the most part may be classified under the headings of propagation of electric waves, directional wireless, atmospheric disturbances and the development of apparatus and technique for standardisation and measurement.

Much of the work of the Radio Research Board involves resources which are quite beyond those of any university or even of any commercial organisation or self-contained Government department engaged upon a specific aspect of communication. The Radio Research Board combines the advantages for its staff of freedom from the continued stress of direct commercial application of the results of their work, with the co-operation which is obtainable from those who utilise radio communication in one or more of its many aspects. This co-operation is readily provided because the user administrations realise that the results of the research will frequently be of direct benefit to them in their own work. Further, the operation of such a research board provides a team of trained experts, whose advice and experience is readily available in connexion with the many problems arising in the progress of radio communication. In some cases the organisation has been regarded as a source of trained personnel for industry.

The Australian Radio Research Board began in 1926, with all the benefits of the experience of the British organisation, and indeed, many members of its staff were trained under the British Radio Research Board. Canada entered the field in 1930 with a committee appointed under its National Research Council.

While these research organisations overseas deal with particular radio problems which are local to their countries, they also conduct programmes of research which are very similar to that mentioned above in progress in Great Britain. This is the result of what is considered to be an important feature of the British Board, in that it recognises the Imperial aspect of the problems with which it has to deal; it is thus always ready to co-operate fully with the Boards of the Dominions Overseas, not only by suggesting a common and suitable programme of work, but also by giving freely of the advice and experience of its staff, and even in some special cases by the supply of necessary apparatus.

It is surely time that India was able to take its place in such a world-wide scheme, and it is to be hoped that those in a position to do so will foster the inauguration of a suitable Radio Research Board and provide the necessary funds to initiate its work. The research already carried out in India indicates that the universities are ready to provide a programme of problems of a fundamental nature, and even the nucleus of a staff of trained personnel, keen and enthusiastic to continue their investigations, which are at present being limited through lack of resources.

'Out of the East'

Soviet Communism: a New Civilisation? By Sidney and Beatrice Webb. Vol. 1. Pp. xix+528. Vol. 2. Pp. x+529–1174. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 35*s.* net.

IT may seem a little late to be embarking upon a review of Mr. and Mrs. Sidney Webb's (one must defer to their own designation of themselves) book on communism in the Soviet State. But it is not a book to be treated in the hasty way of ordinary reviewing; it has to be read. Still more, it possesses the character of a monument, and one needs to stand back from a monument in order to appreciate it properly.

The book, one hears, is the outcome not merely of two personal visits to Russia and a wealth of documentary study, but also of many inquiries and journeys by other observers. But the Webbs have taken upon themselves the task of reducing the mass of material thus accumulated into form, and have produced not a digest but a living book, vital with that sustained passion for human progress which has marked the whole lives of these two great workers. *Pour faire quelquechose de grand il faut être passionné.* We can only bow in respectful admiration to the man and woman who have carried through such an undertaking when both are nearing their eightieth year.

The first volume is occupied by a description of the form of government and administration within the Soviet Republic. The most usual criticism is that the Soviet State has only replaced the old Russian autocracy by a new tyranny, even by a dictatorship, at first in the person of Lenin, now of Stalin. In their sixth chapter the Webbs have an interesting discussion on the point, whether dictatorship can be attributed to Stalin or the Communist Party itself. Stalin holds but a subordinate position in the Government, and a reply of his to the effect that "Single persons cannot decide. The decisions of single persons are always or nearly always one-sided decisions" is contrasted with a remark of Mussolini's: "I am an individual absolutely refractory to outside pressure of any kind". Possibly either statement aimed as much at effect as the whole truth, but there is evidence in justification of both.

The earlier chapters are devoted to explaining how the Government is built up as a pyramid of soviets based upon the popularly created village and city soviets; they in their turn send delegates to the rayons, above which are the oblasts, including the twelve autonomous republics. The next tier of councils is that of the seven constituent republics, of which by far the greatest is the Russian Socialist Federal Soviet Republic with its capital at Moscow, and at the top comes the U.S.S.R., the Soviet State proper. "From top to bottom of this pyramid of councils, each tier has complete authority over all below it, and is itself completely subject to all above it". While the village soviets are elected on ordinary lines, in the cities the electoral groups are not wards or districts but institutions like factories or offices. "The actual unit of the electorate in the urban communities of the U.S.S.R. is everywhere a relatively small assemblage of persons, usually a few hundreds and seldom exceeding one thousand, who, wherever they reside, or whatever their grade, or industrial status, or particular craft, or vocation, are for the most part habitually meeting each other in daily work".

Men and women become voters at the age of eighteen, but there is a 'deprived' class which may neither vote nor be elected. This includes rentiers, clergymen, employers of labour working for their own profit, commercial agents, imbeciles and certain classes of criminals. But the 'deprived' class, once perhaps ten per cent of the electorate, has been shrinking, and is to disappear when the new law of elections comes into action. The writers insist on the entire freedom of election and on the play of discussion on persons and projects which persists throughout all the grades; they hold that in fact government, from the village soviet to the Sovnarkom or Cabinet, proceeds through committees and is neither autocracy nor bureaucracy. Again the Webbs give examples to show the participation of the people at large in the business of government, due in part to the smallness and intimacy of the initial Soviet groups. For the time being, at any rate, there is none of that apathy about voting which characterises our municipal and district council elections.

Of immense importance are the relations between the central power and the various nationalities in the vast area of what is no longer Russia but the Soviet Republic, itself made up of seven constituent republics which include other autonomous republics and oblasts, each representing a 'nationality'. The old drive for 'Russification' has been abandoned; instead, the republics participate in an 'un-national State' but exercise control of language, religion, education and economic development within their own areas.

The national unit may be as large as the Ukraine with thirty million inhabitants, or as small as the Volga German Republic with six hundred thousand ; even the Jewish community at Biro-Bidjan needs but a little more population to become recognised as an autonomous republic.

The principle is thus to allow each national group control of its own imponderables, so much so that in the authors' opinion "the Soviet Union, alone amongst the countries of Eastern Europe, can claim, with a high degree of accuracy, that it has solved the difficult problem presented by the existence of national minorities within a strongly centralised state". Doubtless also some unifying effect comes from the liberation accompanying the Revolution, just as the French Revolution united for ever national groups as diverse as the Bretons and the Alsatians or the Catalans and the Basques. There are, however, limits to the autonomy ; the national groups may not enter into relations with fellow nationals outside the U.S.S.R. ; there can be no Nazi propaganda within the Volga German Republic. "The local authorities could give preference to their own nationals as teachers and local officials and were even encouraged to do so. Their religious services were not interfered with by the Central Government. They could establish theatres, and publish books and newspapers in their own tongues. These were exactly the matters in which local autonomy was most desired". But the Federal Government, the Soviet State proper, retains certain powers within which all Governments must work ; for example, foreign relations, the armed forces, transport and communications, currency and State loans are reserved. Even more important reservations are the definition of citizenship, the monopoly of all external trade, and the "foundations of the whole people's economy", which means the elimination of the capitalist and the landlord as receivers of profit from organised labour, which indeed constitutes the spiritual basis of the Soviet Union.

An important chapter discusses the position of the Communist Party, that order or vocation numbering only some three million men and women, which has no place in the constitution but which pervades the whole life of the country. Members are admitted only after probation, and may be expelled for any failure to live up to the standard of personal conduct that is set ; they must accept a limitation of income and absolute discipline to be sent hither and thither wherever the Party thinks stimulus or organisation is needed. But they can obtain administrative power only by election to the Soviets, otherwise they work by propaganda and influence. The Party may be compared to a religious order like the Jesuits ; its vocation is leadership ; its driving power is derived from "the impulse of a faith—which communists will not allow us to call a new religion, but which has all the impelling force that religions have elsewhere possessed". "In fact in the nature of its mentality, as in the direction of its activities, the Communist Party reminds us less of a religious order than of the organisation of the learned professions of Western Europe, such as those of the lawyers and doctors, engineers and public accountants. Like these and many other professional bodies, the Communist Party concerns itself exclusively with the affairs of this world".

These political sections of the book merit the earnest consideration of all students of government and administration. We are conscious that with the increased complexity of modern life our well-tried democratic machinery of elected Parliaments and local authorities is working indifferently. It is subject on one hand to irrational responses to emotional appeals, still more subject to excessive delays in taking action on matters which may be economically or socially important, but possess no 'slogan'. Indeed, it is this impotence of Government which is inducing in so many of our younger men and women a denial of the democratic principle in favour of Fascism or any other autocracy. The Soviet system offers many examples of administration which may prove the salvation of democratic government.

A large section of the first volume is devoted to a consideration of the machinery of production. In the first place we must dismiss the popular idea that in the communist organisation all men are paid alike ; there are differential rates of wage, and piece-work is encouraged. Nor is there a pattern organisation ; besides the trade unions, which control most of the larger industries, there are associations of owner-producers who divide the profits of the enterprise ; and on the land greater variations of management are to be found. The authors give much consideration to the trade unions, which differ from our trade unions in that they include for each establishment the whole of its staff, from the manager and the technicians down to the cooks in the canteen, as well as the doctor and the nurses of the hospital belonging to the works. There is a lively account of the struggle that took place to convert the trade unions from monopolies concerned only with raising wages into organisations aiming at increased efficiency and reduction of costs, into agencies working in fact for the national economy rather than individual profits.

Another important chapter deals with the other end of the chain, the organisation of consumers' co-operatives through which the goods produced get to the public. This is a problem which troubles all communities at the present time ;

price fixing only authorises excessive profits, yet voluntary co-operation languishes.

In their second volume the Webbs proceed to a consideration of the organisation upon which the existence of the U.S.S.R. essentially depends—the planning of the national economy. The idea is simple enough—to provide work for everyone in producing the commodities in universal demand, and to organise the exchange of these commodities so that everyone's demand is satisfied up to the stage that production can attain. Every improvement in output is welcomed as adding to the opportunity of meeting the requirements of the consumer. The possibility of over-production—the bugbear of the capitalist world—is met by a sufficient switching over to production of some other commodity. A community can become rich up to its capacity of all-round production when all are at work and trade is reduced to an exchange of commodities that is not activated or controlled by considerations of the profit to be made. So obvious seems the principle that most people deny the possibility of putting it into practice; on the ground that human capacity is not equal to such a task of organisation. The Webbs explain the vast organisation of Gosplan, the U.S.S.R. State Planning Commission. They set out the objections urged by the orthodox economists, who start with the principle that maximum efficiency is secured in a free market because "prices in the market places are in effect a continual referendum on what men wish to produce, what they wish to consume, where they wish to work and where they wish to invest their savings". To this the Webbs' answer is to ask where in the capitalist world does the free market exist. In the Soviet State, planning *is* working; what other State is free from unemployment or artificial restriction of production? The technique required is no more than that already achieved by such organisations as Imperial Chemical Industries, Ltd., the United States Steel Corporation, and the General Electric Corporation. As to the freedom of choice postulated by the orthodox economist, they observe that "the vast majority of the commodities displayed in the public markets or in the shops of the London streets are as effectively forbidden to two-thirds of all the inhabitants of England as if this large majority were statutorily prohibited from purchasing them". The system does, however, demand a closed community, so nearly self-sufficient that foreign trade is of minor importance.

The greater part of the second volume deals, however, with the social aspects of life in the Soviet Union. There are descriptions of the amazing development of public hygiene, practically unknown in Russia before the Great War, of maternity benefit, sickness, invalidity and old age benefits, and other efforts to ensure economic security for all workers. Other sections deal with education, physical and artistic culture, housing and town planning. Readers of NATURE will be specially interested in the chapter dealing with science and research, for the Soviet Union claims to base all its planning upon science, as the only means of increasing aggregate production which on its system can be distributed, and does not lead to a stoppage of industry through over-production. It is claimed that the scientific men and technicians are obtaining increasing powers of leadership, though since human nature cannot be ousted they are always liable to be 'put in their places' by the administrator or the political 'wire-puller'. Even delation is not unknown. The real point is that the people at large are being brought up to regard science as the guide to life instead of as an uncomfortable and plebeian encroachment on the old order. The Academy of Sciences is described, and also the Communist Academy, which concerns itself with economics and what used to be called social science. No one can doubt but that the Soviet Union has thrown immense energy and almost unlimited resources into the prosecution of research, not only in applied but also in the basic sciences here distinguished as 'pure' science. But the scientific reader will be rather put off by the claims that the Soviet Academy "is unique in its close contact with the manual workers", or the particular account of "the widespread popular participation in scientific research". It is one thing to be interested in the theory of relativity, and another to share in the mathematical reasoning out of which the theory grew. Indeed, there is danger to the research worker in this publicity; it leads to premature publication and the forcing of results.

What perhaps the English reader most wants to know is how far the average man or woman is free to conduct his life in his own way. It appears that he can earn more or less, that he can save and even invest, but his income is limited by a very steeply graduated income tax, and similar death duties prevent the creation of a rentier class. He may acquire private possessions, limited again by the restricted housing he will be allowed; he is not even compelled to work, though as a non-producer he will not obtain a ration card and so must buy as a foreigner does. But he may not leave Russia without permission and he may not accumulate a reserve of funds abroad. There is freedom of marriage and of divorce; for the woman, abortion is legalised but must be carried out in a public hospital by an appointed surgeon; none the less, loose sexual living is being strongly discouraged. Any religion may be practised, but religious propaganda is forbidden; just as there is

freedom of political, philosophic and economic discussion, provided it does not take the form of agitation against the Marxian system or 'grousing' that will lead to slackness of work or sabotage. Unsocial conduct is the crime that may lead to sentence without trial, and for this, as for the delations that take place and the melodramatic trials of experts and managers that have been staged from time to time, the authors can only plead that the Soviet Union has not yet emerged into full security, but has been living in an atmosphere of external hostility that did not scruple to foster treachery within. In general, "freedom is as much the presence of opportunity as the absence of restraint", and in this sense freedom is broadening every year in the Soviet Union.

The Webbs agree that no one in the Soviet State can exercise the liberty of action and the opportunities for personal enjoyment—sport, travel, the æsthetic delights of gardens, fine prints or old wine, that in Britain are open to a rich man or even in a modest way to a professional man. The Soviet Union has set up an ascetic ideal and even the Webbs cannot persuade us that within it there is not lacking much of the colour and variety which to us makes life interesting, but then what an enlargement of living has it not afforded to ninety per cent of its population ?

It must not be taken from this brief summary that the book is a mere compendium of legislation and administration. It is eminently readable (by the way, a future edition should be given an adequate subject index); it is enlivened by argument and illustration, and by criticism of our own conditions based on the Webbs' intimate acquaintance with public administration in this country. It rises to a sober eloquence kindled by the authors' enthusiasm when they see this or that reform, for which their lifelong efforts have been preparing, in process of realisation. It is indeed a work of ultimate significance to the English-speaking world, for it does present a reasoned account of 'the results and aspirations' of the Soviet experiment. Experiment must still be the term for a phase of human society that is not yet twenty years old. But its advent is an event in human history like the spiritual emancipation that came with Christianity and the political emancipation that culminated in the French Revolution. It may be submerged by war, but its ideal of a classless society actuated by other motives than private profit will always be fermenting in the minds of men and women, moving them towards its realisation within all societies. It is for these other societies not to attempt to swallow the Soviet system as a formula, but so to assimilate its lessons and adapt them to their own racial cultures, without having to pass through the cruelties, destruction and waste that marked the Russian Revolution.

A. D. HALL.

New Conceptions of Disease in Early Childhood

Disease in Childhood : a Clinical Study. By Dr. Robert S. Frew. The First Year : Birth to One Month, One Month to Six Months, Six Months to One Year. Pp. xv + 669. (London : Macmillan and Co., Ltd., 1936.) 30*s*. net.

IN his preface to this book the author explains that his material is mainly drawn from 8,823 cases seen during seventeen years as physician to the out-patient department of Great Ormond Street Hospital, London. These cases he has arranged in three age groups—namely—those of the first month of life ; those of one month to six months ; and those of six months to twelve months. This method is thought to offer a better means of studying the special characteristics of disease as it exists during these periods of life. It is clearly implicit in this method that there must be much repetition. The book as a whole has, however, the merit that the author's observations are founded on his own personal experiences, and is not a mere compilation. The majority of medical men who write books, or at any rate first editions, do so at the commencement of their careers, at a time when they have more leisure than experience. Medical books are indeed seldom written at the end of a successful career, when a man has neither the energy nor the incentive to give the world the benefit of his mature experience.

The author of this book has refrained from committing himself to print until he has had experience greater and more valuable than is usually vouchsafed to medical men. Throughout his medical career, Dr. Frew has ploughed a somewhat lonely, albeit contemplative, furrow. He has joined but little in the hurly-burly of medical debate or controversy, and has contributed very little to professional literature. He has not, therefore, been subjected to the fire of criticism which usually beats about the head of the medical publicist, or one who invents theories.

Such criticism, though chastening, has usually a very salutary effect. If before writing his book Dr. Frew had come out into the open and submitted his views, most of which are new and original, to the criticism of his medical colleagues, he would probably have avoided falling into several pitfalls which it is not difficult for the observant reader to detect.

Without wishing to suggest that Dr. Frew is *homo unius libri*, he can scarcely hope to escape the gibe that he is a man obsessed with one or two very imperative ideas which insinuate themselves on almost every page of this book. One of these is that the majority of inborn diseases, the effects of which are manifest during the neo-natal period, are due to a condition which he calls 'hyperphlebæmia', an ugly term which is meant to express a condition in which an excessive quantity of blood is forced into the intra-corporeal venous system during birth, before it is ready to receive it. The expression venous engorgement, congestion, or even stasis, might have satisfied the requirements of more ordinary folk, but perhaps Dr. Frew hopes by the sesquipædalian dimensions of the term to convey an impressiveness which would not attach to a simpler nomenclature. Although 'hyperphlebæmia' offers a very good explanation of many of the hæmorrhagic conditions which are associated with the neo-natal period, it is asking a good deal to expect that it will be accepted as an explanation of such conditions as epilepsy, deaf-mutism, congenital blindness, cretinism, cœliac disease, spasmophilia, and even rickets. Yet Dr. Frew is prepared to extend this particular theory so as to cover these conditions also.

Another of the author's comprehensive theories is that certain congenital abnormalities owing their foundation to conditions which are operative at the beginning of intra-uterine life, such as mongolism, achondroplasia, microcephaly, harelip, and congenital heart disease, are due to some abnormality in the yolk supply.

Dr. Frew shows great ingenuity in finding an etiological explanation for many conditions which do not come under either of these categories. For example, his explanation of the causation of congenital anal stenosis, pyloric stenosis, and Hirschsprung's disease, are unlike any of those of which we have previously heard; they may be true all the same.

To our thinking, the least convincing part of this book is that which appears under the heading "Re-adjustments of the Methods of Nutrition". Reading this section we cannot help thinking that the author does not attach great importance to the niceties of "the new knowledge of nutrition". For example, he regards breast milk as a perfect food, which cannot therefore be responsible for errors of nutrition developing in the baby who consumes it. As a matter of fact, breast milk is frequently deficient in several essential elements, and it may contain toxic substances—hence, therefore, it may be the cause of disease. Moreover, it is practically never sterile, which Dr. Frew considers to be one of its virtues.

There can, however, be no doubt that this is one of the most original and arresting of medical publications that have appeared within recent years on the subject of the diseases of infants, and it will certainly arouse great interest in medical circles, even though it gives rise to much criticism.

Colloidal Science in Agriculture

Colloids in Agriculture

By Dr. C. E. Marshall. Pp. viii+184. (London: Edward Arnold and Co., 1935.) 5*s*. net.

IS a man a better farmer for understanding the meaning of the word colloid? Dr. Marshall evidently thinks so, since he has written his book for agricultural students, rural instructors, district lecturers and county organisers. His plan is first to outline the classical investigations of colloid science and then to apply some of the principles which emerge to agricultural subjects. All this is admirable so long as it is agreed that instruction of this kind is wanted. But is it?

To express a doubt is not to deny the value of general knowledge of things scientific in broadening the mind. This is quite another matter, since such learning need have no connexion with everyday needs. Presumably the author considers that his book will help farmers to farm, but it is difficult to see how. The pure science background needed for an understanding of the book is considerable. If this background is vague, the reader's understanding of colloids will be vaguer still. What use can this be to a farmer in tackling his practical problems? Even if he were really to assimilate the interesting section on insecticidal and fungicidal sprays, he is told at the end that he is largely in the hands of the manufacturers, and that the chemist can add but little to his own experience

and the advice of others. The reader gets little more assurance from the chapter on milk products. He is told that the colloid chemistry of butter-making affords one of the most striking examples of a highly developed technical process the fundamental principles of which are still not understood, and that much less is known of the colloid chemistry of cheese-making.

In his discussion of soil, the author misses his best chance of showing that its colloidal nature is of great importance to the farmer through the phenomenon of base exchange. True, this property is still under investigation; but there is much definite information which could have been put in a practical form that would have shown the magnitude of the base-holding power of various classes of soil in relation to the nutrient requirements of crops. The three references to base exchange are too academic and also too scrappy to be of service to practical agriculturists.

The investigation of the soil from the colloidal point of view is of recent development, and it is no discredit to those concerned that much of the field is still *sub judice*. Until the position has been clarified by further research, and indeed until a more straightforward definition of the word 'colloid' can be given, it seems better to refrain from forcing the subject into prominence in the curriculum of a course in agriculture. The teaching methods which Dr. Marshall condemns as haphazard may be better than he thinks.

R. KENWORTHY SCHOFIELD.

Electricity in Metals

Elektronenleitung:
Galvanomagnetische, Thermoelektrische und Verwandte Effekte. Von Prof. W. Meissner. Unter Mitwirkung von Dr. M. Kohler und Dr. H. Reddemann. (Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Band 11, Teil 2.) Pp. xii+547. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 44 gold marks.

So much has recently been written on the theoretical aspects of the conduction of electricity by metals, of the problems of supra-conductivity, of the poor conductor and of galvanomagnetic effects that it is very satisfactory to have available this excellent book on the experimental side. For it marshals the experimental facts in a handy manner, and deals with the proof of fundamental laws like that of Ohm and with the more recent characteristic temperature relations such as that of Grüneisen, and illustrates them with a wealth of experimental data which can only be found with difficulty elsewhere. The technique and results of modern work on resistance of metals under pressure and on the influence of magnetic fields upon resistance are well described. The survey of the electrical behaviour of alloys is adequate and special attention is paid to the resistance of powders. The determination of the Wiedemann-Franz ratio is fully discussed and the data well considered. Supra-conductivity, naturally, receives very full treatment from W. Meissner, and many readers will find the section of the book which deals with it particularly valuable. Some discussion of photo-electric effects is given, but as these were fully treated in vol. 23 (Part 2), only special features are dealt with here. The first part of the book closes with an interesting outline of modern theories of electrical conduction.

The second part of the volume deals with galvanomagnetic and thermomagnetic effects and forms an important source of information; for the descriptions of experimental measurements of the twelve separate effects into which galvanomagnetic phenomena may be divided are to be found scattered throughout a wide range of original papers, and little seems to have been done to classify these experiments or to compare them at all critically. It can be said, too, that the treatment of thermo-electric phenomena is unusually clear and good, particular emphasis being placed on the properties of single crystals.

Some fifty-four pages of references are given, and it is here that an improvement could easily have been made. Presumably, the subject matter of each reference is discussed somewhere in this book, and it would have been very helpful if the number of the page on which it is treated had been added. On perusing these many hundreds of references, one cannot help being struck by the small number of the references to papers published by the Royal Society and the Physical Society, and one wonders whether atomic physics has virtually excluded the matters dealt with in this book from these publications, or whether the latter tend to be overlooked in Germany. The printing and illustration of the volume are, of course, of high standard, and it can be thoroughly recommended to all interested in these branches of physics.

L. F. B.

Vergleichende Länderkunde

Von Alfred Hettner. Band 3: Die Gewässer des Festlandes; Die Klimate der Erde. Pp. viii+202. 7.40 gold marks. Band 4: Die Pflanzenwelt; Die Tierwelt; Die Menschheit; Die Erdräume. Pp. x+347. 13 gold marks. (Leipzig und Berlin: B. G. Teubner, 1934–1935.)

THE two concluding volumes of Prof. Hettner's treatise on physical geography adhere to the principles laid down in vol. 1 and, while he deals with the continental areas in particular, he includes also the oceanic islands but excludes the oceans themselves. In some respects it is to be regretted that this omission has been considered desirable, for the complete work is one of considerable value, and its usefulness would have been enhanced by the inclusion of a section on oceanography.

Vol. 3 is divided into two sections, the first devoted to a discussion of the hydrosphere, in a limited sense and excluding the oceans. Under this head the author deals with snow and ice, springs, rivers and lakes. The second section consists of an excellent and comprehensive treatment of climatology, concluding with a regional discussion of the subject.

The final volume, in which the author deals with the geography of plants and animals together with a brief discussion of human geography, is probably the most interesting part of the entire work. It is to the final section in particular that the title of Prof. Hettner's book most aptly applies, and it is to be regretted that this section could not have been considerably expanded.

As a whole, the four volumes provide an exceedingly useful text-book, which should appeal to more advanced students of geography, and which covers approximately the same ground as de Martonne's "Traité de Géographie Physique".

Primitives and the Supernatural

By Lucien Lévy-Bruhl. Authorized translation by Lilian A. Clare. Pp. 405. (London: George Allen and Unwin, Ltd., 1936.) 18*s*. net.

M. LÉVY-BRUHL here adds to his previous studies of the primitive mind an examination of its reactions when confronted with the supernatural. As is well known, in his conception, the working of the primitive mind is so far removed from the logic of developed reasoning as to warrant regarding its processes as belonging to a different order. It has no conception of the world of abstract thought, of causation, of categories and the like. Its cosmos is unpredictable and unstable; it is a realm under the control of spirits, both good and evil, who are to be propitiated and if possible controlled. In these conditions it seems difficult to draw the line between normal and supernormal, natural and supernatural. M. Lévy-Bruhl, whose knowledge of the literature of the subject is stupendous, here passes in review the ceremonies and rites, and the beliefs and customs relating to omens, amulets, ancestor worship, purification and the like, whereby primitive man has endeavoured to secure that the course of events either shall turn to his advantage or at least not be to his detriment.

Tabulæ Biologicæ Periodicæ

Herausgegeben von C. Oppenheimer und L. Pincussen. Band 4, Nr. 4 (= Tabulæ Biologicæ, Band 10, Nr. 4). Pp. 289–388. Complete vol., 55 gold marks. Band 5, Nr. 1 (= Tabulæ Biologicæ, Band 11, Nr. 1). Pp. 144. Band 5, Nr. 2 (= Tabulæ Biologicæ, Band 11, Nr. 2). Pp. 145–224. Complete vol., 55 gold marks. (Den Haag: W. Junk, 1935.)

THE data given in these parts of Tabulæ Biologicæ Periodicæ are arranged as in the previous volumes. The fourth part of vol. 4 contains the concluding part of an article by Th. A. Maass on the biology and toxicology of chemical substances used in war; it also contains the index to the volume. K. Boresch contributes articles on the mineral content of plants, the first in vol. 4 and the second in vol. 5 (No. 1 and 2). The most important contribution to vol. 5 is a long article on allergy (or sensitiveness to proteins foreign to the body) by Th. A. Maass, whilst O. Reitz summarises our knowledge of heavy water.

Practical Biology for Medical Students

By C. J. Wallis. Pp. xii+247. (London: William Heinemann (Medical Books), Ltd., 1936.) 12*s*. 6*d*. net.

THIS laboratory manual gives detailed practical instructions to students of biology for first medical examinations and also supplies additional matter in order that it may satisfy the Higher School Certificate examinations in the subject. An unusual but useful feature in such a book is a separate section on elementary biochemistry.

Those diagrams which are not borrowed from other sources tend to be rather crude, and in places, if not misleading, then of little practical value to the student.

The book should prove useful to the teacher of biology. Since a theoretical text-book would be necessary for a student taking a course such as is provided by this book, its high price is unfortunate.

The Identity Theory

By Blamey Stevens. Second edition, revised and amplified. Pp. xvi+252. (Manchester: Sherratt and Hughes, 1936.) 12*s*. 6*d*.

THE object of this book is to build up a complete system of mathematical physics on a basis that is very different from that currently accepted. The fundamental assumptions are that inertia, time and space are each complete measurements of the same thing, and that by expressing this identity we get the laws of physics. For example, the space-time identity leads at once to the result that the observed velocity of light is independent of the motion of the observer, the fundamental postulate of relativity. Other identities lead to Maxwell's electromagnetic equations, Newton's laws of motion and a theory of relativity. The later chapters deal with radiation and the quantum theory. Whatever may be thought of the author's conclusions, he shows considerable knowledge of physics and mathematics.

Holiday Sunshine in the British Isles*

IN the absence of any long-range forecasts, made along strictly scientific lines, as to the occurrence of sunny periods during the year, the accumulated statistics of past sunshine records warrant a special study. They serve as a guide to the average conditions for any season. Although few are fortunate enough to select the time for their holidays, all have some choice in the matter of locality. Sunshine, in these days especially, may be regarded as the most important meteorological requirement for an enjoyable holiday.

The data are described as referring to bright sunshine because a certain intensity is required before the recorder will register. The standard instrument of the meteorologist for recording sunshine is of the Campbell-Stokes pattern, in which the duration of sunshine is recorded in the form of a scorched or burnt line, traced on a graduated card by means of a spherical lens acting as a burning glass. The instrument was first introduced by Mr. J. F. Campbell in 1853 at the Office of the Board of Health in Whitehall, and afterwards modified by Sir George Stokes to receive a strip of cardboard on which to record the focused rays of the sun. Records from these instruments were first published in 1880, and the number of climatological stations reporting to the Meteorological Office has steadily increased, so that in 1934 it was possible to publish averages of bright sunshine for 171 stations in the British Isles for periods ending 1930, usually 1901–30. Naturally, the stations are more numerous in the south of England and fewest in the relatively uninhabited mountainous regions. In many districts the distribution has had to be inferred from records outside these areas. This renders all the more important the record maintained at Ben Nevis Observatory, at an altitude of 4,400 ft., during the years 1891–1902 for which the mean values in hours were : J. 0·64 ; F. 1·61 ; M. 2·06 ; A. 2·88 ; M. 4·27 ; J. 4·14 ; J. 2·95 ; A. 2·00 ; S. 1·91 ; O. 1·58 ; N. 1·02 ; D. 0·55 ; Year 2·13. Actually this station is probably the least sunny in the whole of western Europe. The frequency of cloud is confirmed by the fact that those climbing to the summit are but infrequently rewarded by a good view.

It is well known that the average amount of sunshine tends to decrease from south to north and from the coast inland. Before considering the distribution of bright sunshine over the country generally, and from month to month, it seems desirable to define the total possible duration. The duration of possible sunshine is referred to as the interval between the ascending and descending transits of the centre of the sun's disk across the horizon, as actually seen. The mean daily duration of possible sunshine is set out in Table 1 for each month of the year for latitudes 50°, 52°, 54°, 56°, 58° and 60° N. Latitude 50° corresponds roughly with the Lizard ; 52° with Valentia, Cork, Fishguard, Hereford, Buckingham and Felixstowe ; 54° with Blacksod Point, Greenore, Morecambe and York ; 56° with Helensburgh and Leith ; 58° with the south of Lewis and Lairg ; and 60° with the south of the Shetland Islands. The statistics show that at mid-summer the possible duration of sunshine in the north of Scotland is about two hours greater, and at mid-winter nearly two hours less than that in the south of England. On the other hand, there is very little difference with latitude for both March and September.

Table 1.—Daily mean duration of possible sunshine.

Month	Latitude (North)					
	50°	52°	54°	56°	58°	60°
	hr.	hr.	hr.	hr.	hr.	hr.
January ...	8·6	8·3	7·9	7·6	7·2	6·7
February ...	10·0	9·9	9·7	9·5	9·3	9·0
March	11·8	11·8	11·8	11·7	11·7	11·7
April	13·7	13·8	14·0	14·1	14·3	14·5
May	15·3	15·6	15·9	16·2	16·6	17·0
June	16·2	16·6	17·0	17·4	17·9	18·6
July	15·8	16·1	16·5	16·9	17·3	17·9
August ...	14·4	14·6	14·8	15·0	15·3	15·6
September ...	12·6	12·6	12·7	12·7	12·8	12·9
October ...	10·7	10·6	10·5	10·4	10·3	10·1
November ...	9·0	8·8	8·5	8·2	7·9	7·5
December ...	8·1	7·8	7·4	7·0	6·5	5·9
Year	12·20	12·22	12·23	12·25	12·27	12·30

The most convenient procedure, in the case of the British Isles, is to consider each average value of bright sunshine as a percentage of the possible duration. So far as the annual values are concerned the largest percentages (40 per cent or more) occur along parts of the south and south-east coasts of England, including the neighbourhood of Torquay, from Weymouth to Dungeness, most of the Isle of Wight as well as near Margate and Felixstowe. Stations in Jersey and Guernsey report 42 per cent, and as much as 41 per cent occurs at Bognor Regis, Eastbourne, Worthing and Sandown. The area with more than 35 per cent extends along the west coast to include parts of the Isle of Man and Anglesey and the neighbourhood of Llandudno, and along the east coast almost to the Humber. Less than 30 per cent occurs over a large area stretching northwards from central Wales and the Midlands to include

* The information in this article is based on a paper on "The distribution over the British Isles of the average duration of bright sunshine : monthly and annual maps and statistics", by Dr. J. Glasspoole and D. S. Hancock, published in the *Journal of the Royal Meteorological Society* for April 1936.

most of Scotland, apart from coastal districts south of the Isle of Skye on the west and Aberdeen on the east. The island of Tiree gives the surprisingly high value of 35 per cent and Lossiemouth, on the Moray Firth, as much as 30 per cent. Over the mountainous districts of central and northern Scotland bright sunshine occurs on only 20–25 per cent of the possible duration. Over Ireland the range is small, being from 35 per cent in the extreme south-west to 28 per cent in the north-west. The smallest values in England, of just less than 25 per cent, occur in certain industrial areas of the Midlands. In the suburbs of London bright sunshine occurs on about one-third of the total possible time and this proportion is experienced in coastal districts as far north as Morecambe, parts of the Isle of Man and Spurn Head, and also in certain of the flatter islands to the south-west of Scotland, such as Tiree.

The distribution over the country for each month is similar to that shown on the annual map so far as the localities of much or little sunshine is concerned. The actual values increase steadily, however, from December until April, May or June. The minimum percentage occurs at most stations in December, although a few give similar percentages in December and January, such as Armagh in Northern Ireland, Torquay and Durham. There is less than 10 per cent in the neighbourhood of the manufacturing towns near Manchester, and in the mountainous districts of the north-west of Scotland in both January and December. On the other hand, percentages of 45 per cent and more occur in six months. Such percentages occur as early as April along the coasts of Cornwall and south Devon and at isolated coastal stations in the south-east, and in May, June, July, August and September along most of the south and south-east coasts from Torquay to Lowestoft. Percentages of 45 or more also occur in April and May in Tiree. They cover the largest part of the British Isles in May. In June these values also occur in the neighbourhood of the Severn Estuary. In May the average amounts of bright sunshine reach half the possible duration, when they are confined to a few coastal stations in the extreme south-east of England from Eastbourne to Felixstowe.

The sunniest month of the year is either April, May or June over practically the whole of the British Isles. *April* is the sunniest month in the Outer Hebrides, in the neighbourhood of Loch Ness, near Aberdeen, and the extreme south of Cornwall. *May* is the sunniest month from Mull to northern Aberdeenshire, in the south-west of Scotland, in the south-west of Ireland, near Aberystwyth and over most of the south-eastern half of England. *June* is the sunniest month over central and south-eastern Scotland, the south-east of Ireland, and most of the north-western half of England and Wales. *July* nowhere gives the largest percentage values for the year (although in the neighbourhood of London July ranks as the sunniest month in actual hours). *August* is the sunniest month only at Lowestoft and in Jersey and Guernsey, but it ranks with May at Greenwich. Most stations show a fairly simple increase in the percentage values from December to the early summer months, but there is a subsidiary maximum in August in parts of the south-east of England and the Midlands, and a subsidiary maximum in September over most of Scotland, the north-west of England and Ireland. At Newquay there is little difference in the percentage sunshine for April, May and June, and at Torquay between May, June and July.

Table 2.—Average General Sunshine, 1901–30, as percentages of possible.

	England and Wales Per cent	Scotland Per cent	Ireland Per cent	British Isles Per cent
January	18·3	14·6	18·2	17·3
February	24·0	23·6	23·6	23·8
March	30·3	28·5	30·9	30·1
April	35·0	34·8	37·7	35·6
May	40·0	34·4	36·2	37·6
June	40·2	33·9	35·2	37·2
July	36·9	28·3	31·6	33·3
August	37·0	27·7	31·3	33·1
September	37·4	29·4	32·2	33·8
October	30·4	25·8	27·5	28·5
November	23·7	20·1	23·8	22·9
December	16·7	13·0	17·0	15·8
Spring (March–May) ...	35·1	32·6	34·9	34·4
Summer (June–Aug.) ...	38·0	30·0	32·7	34·5
Autumn (Sept.–Nov.)	30·5	25·1	27·9	28·4
Winter (Dec.–Feb.) ...	19·7	17·0	19·6	19·0
Year	30·8	26·2	28·8	29·2

The average general values for the months and the seasons are given in Table 2 for England and Wales, Scotland, Ireland and the British Isles as a whole. The table emphasises the large values for the bright sunshine in both Scotland and Ireland in April and the appreciably greater sunshine of May than of either July or August over England and Wales.

So far as the total amounts of bright sunshine are concerned, there are therefore obvious advantages in early holidays. Along the east and south coasts, from Scarborough to the Isle of Wight, May has advantages, while along the west and south-west coasts of England June is to be preferred. For holidays in April the records suggest the neighbourhood of Penzance and the Scilly Isles, and in August the Channel Isles. In the English Lake District the choice would fall to May, June or September, before July or August. For a visit to the islands of the south-west of Scotland there are advantages in selecting April or May.

On the average, the sunniest month of the year occurs six months after the least sunny month over a broad strip across central districts of Great Britain. Both to the north-west and south-east

the sunniest month occurs earlier. There is a marked tendency therefore in many localities for the summer to come upon us relatively quickly and for winter to be longer delayed.

It must be admitted that sunshine is only one meteorological factor to be considered in the selection of the best time and locality for holidays. Attention must also be paid to the frequency of rainfall, air temperature and sea temperature. For this reason the procedure adopted in the Handbook of the British Health Resorts Association is a particularly happy one, for it gives the meteorological statistics of each health resort, together with comments on the climate from a medical aspect. It is a comforting fact, however, that in all parts of the British Isles the average annual duration of sunshine exceeds that of recordable rainfall, and that in the south-east of England the duration of sunshine is as much as seven times greater than that of recordable rain.

Percy Sladen Expedition to Lake Huleh

By Roger Washbourn and R. F. Jones

THE Percy Sladen Expedition to Lake Huleh, Palestine, consisting of the present writers, has now returned. Biological investigations have been carried out during the greater part of the period August–December 1935. While much work remains to be done in the sorting and identification of the material, it is nevertheless felt that a preliminary account of the work may be of interest.

As stated in NATURE of October 5, 1935, p. 538, the region called the Huleh comprises two parts, which differ considerably (Fig. 1). The lake is at the southern end of the broad Huleh valley, and is separated from Tiberias by a low range of hills. It is bounded on the northern side by the swamp, which is for the most part an impenetrable tangle of papyrus, but which also contains channels of running water, and pools which may be up to an acre or so in extent. The lake covers approximately 5 square miles, and is of a general depth of 4–6 ft., with occasional deeper holes.

The lake shore is of gravel, where winter-running wadis have brought down much material from the surrounding hills, and where the direction of wave action keeps the stones clear from mud. In quiet places, under the shelter of the gravel spits, the shore is of mud, which in places becomes colonised by *Phragmites*. The bottom of the lake is everywhere of a light greyish mud. This mud is colonised by a great mass of aquatic plants, the stems of which may reach the surface of the water. The chief types present are species of *Myriophyllum*, *Potomogeton*, and *Nuphar*. They occur in large consociations, some of which are practically pure communities of a single species.

The water of the lake is fresh to the taste (accurate analyses of the chemical composition are being made), and the temperature is usually high. Fluctuations in temperature must be considerable ; on one occasion the thermometer was observed to rise from 29° to 31·4° C. in approximately 2¼ hours. The water is alkaline ; the *p*H being approximately 7·8–8·0 during the daytime. The oxygen content was found to be high, and the carbon dioxide content comparatively low.

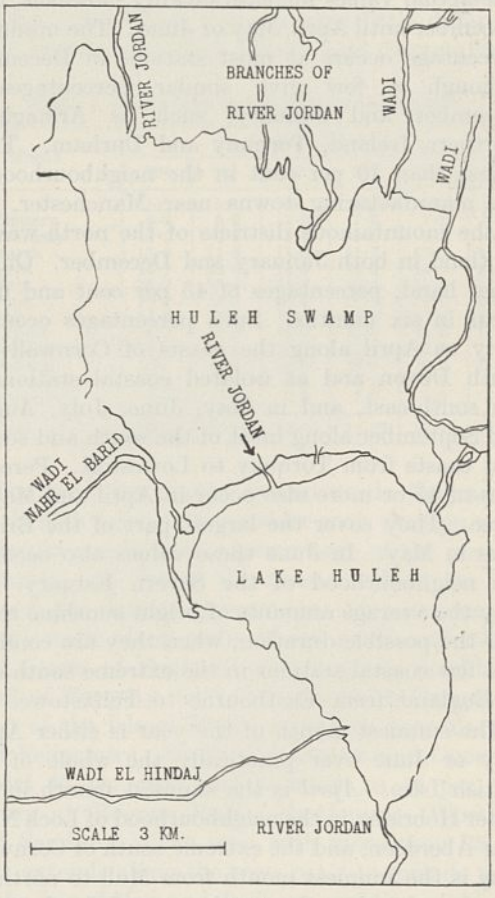

FIG. 1.

The phytoplankton was exceedingly dense, and was probably responsible largely for the constant colour of the lake water. The animal plankton on the other hand was meagre, and by no means

corresponded with Barrois's[1] estimation that it was "an abundant plankton". Quantitative hauls were not attempted owing to the difficulty of hauling in such a small depth of water, and where there is so much rooted plant growth. Systematic hauls were made every month, and are being continued throughout the year, through the kindness of the Jewish Colony at Yesud Hamalla.

The fauna consists of free-swimming, mud-living lithophilous and phytophilous types. Our collections of fish have yet to be investigated, but it does not appear that the fish fauna differs markedly from that of Lake Tiberias. Cichlid fishes are very common, and provide most of the fish for the small fishing community; cyprinids also occur, as does the siluroid *Clarias*. It seems, however, that the actual number of different species is not so high as in Lake Tiberias. In the mud-living community, the striking feature was the amazing abundance of the gastropod *Melanopsis*; one haul of the Petersen grab bringing up a hundred or more individuals.

Considering that a mother-of-pearl industry used to be carried on, and that Hornell[2] describes the unionid lamellibranchs as very common, the numbers actually found were low. *Corbicula*, a common mollusc in Tiberias, is not common in Huleh. Other common animals living in the mud of the lake bottom were many small oligochætes and chironomid larvæ. The stone-living fauna comprises one species of polyzoan, probably *Fredricella*, ephemerid nymphs of the genus *Cœnis*, a species of leech. *Melanopsis* and *Melania* are also very numerous.

Along the northern end of the lake there is a broad mud bank which runs also some way down the western side. This is colonised by a very dense zone of *Nuphar*, mixed with *Ceratophyllum*. To the west this is succeeded on the landward side by *Phragmites*, to the north it may be succeeded by *Papyrus* or *Phragmites*.

In this region, the fauna differs markedly from that of the lake; typical lake forms are replaced by others which occur in the swamp. The lake gastropods occur in numbers in the *Nuphar* zone, where together with various insect larvæ they are the commonest animals. The *Nuphar* zone itself supports a fauna: a coleopteron, several diptera and a lepidopteron. In the *Phragmites* the *Melania* and *Melanopsis* cease to occur, and one finds various species of smaller gastropods, such as also occur in the swamps. *Cœnis* is absent, and the whole character changes completely.

The swamp proper sharply limits the northward extension of the lake. It is approximately three miles broad, and extends northward for another five miles before ending more or less abruptly in reclaimed land, the latter being tilled and used for millet growing.

The most common consociation of the swamp is dominated by *Cyperus papyrus*. This community covers many square miles, and may be found under conditions varying from complete submergence of the rhizomes in water, to cases in which these organs are growing more or less superficially in damp peat. In the submerged state, the thick rhizomes are usually so intermingled as to form a more or less floating raft, usually firm enough to bear the weight of a man, but often not rigid enough to prevent the whole mass sinking for several yards around as one walks on it. The rhizomes lie from a half to one foot below the surface of the water, with the roots growing vertically downwards to the floor of the swamp through a mass of old and decaying papyrus debris. It is difficult to trace these roots in dense papyrus; but in the channels which are kept clear by the Arabs, rhizomes attempting to grow across may be found bearing roots up to four feet in length.

FIG. 2. Lake Huleh from western shore. Photograph by R. Washbourn.

The mass of dead papyrus is continually increasing; but the decomposition is slow, and this, together with the tremendous additional weight of the living papyrus, gradually consolidates the mass into a loose peat which in time raises the level of the floor of the swamp. There are thus formed large areas of papyrus growing on the surface of the damp peat, with the water-level some three or more feet below. This condition obtains during the dry season (June–November), but the heavy rains in January and February cause a rise in the water-level, so that the papyrus is once

more in the submerged condition. The papyrus can grow to a height of fifteen feet, and in spite of the fact that, where it is most dense, it intercepts much of the direct light, enough light passes through to allow the development of a sub-flora. The taller plants, such as *Lythrum salicaria* and *Lycopus europæus*, may reach much of the direct light; but in the lower vegetation stratum there is little else beside a species of fern which grows in great profusion.

The open water system of the swamp is made up of the running water of the channels, the pools and the River Jordan. Fringing the channels there may be *Ceratophyllum* with *Utricularia* and algæ floating among its crowded upper branches. Continual disturbance of the water and the bottom by Arabs prevents to a great extent the growth of the small plants of *Ceratophyllum* in these channels; but once they have fallen into disuse a dense mass of *Ceratophyllum* soon grows up and blocks them.

FIG. 3. A clearing in the papyrus swamp, Lake Huleh. Photograph by R. Washbourn.

The pools may be bordered either by *Phragmites* or by papyrus; they are often covered with *Nuphar* and *Ceratophyllum*; while in many pools *Nymphæa* is common. It is interesting that *Nymphæa* is confined to the swamp and that it was never found in the lake.

Along the stretch of the Jordan which passes through the swamp the banks are slightly raised and are generally covered with papyrus. Along the edge of this papyrus in very deep water there may be a fringing zone of *Polygonum* spp.; *Cladium mariscus* is often to be found near the river bank. On the bank there may be various grasses; *Cyperus* spp. (differing from papyrus), and *Typha* spp. Towards the swamp these are usually succeeded by *Phragmites* or papyrus.

The composition of the water of the swamp differs markedly from that of the lake. The oxygen content, as might be expected, was very low (1–2 c.c. per litre). The *p*H was always neutral or slightly alkaline (about *p*H 7·0) and with an alkali reserve of 0·004 *N*, gives a high carbon dioxide content. The temperatures were all comparatively low, and did not fluctuate very greatly. This suggests that the water may be derived from springs in the swamp itself. Furthermore, on analysis, the water samples from various portions of wet swamp were found to show roughly the same characteristics as that of the channels. It may be that the presence of water in certain parts of the swamp in summer is due to the proximity of channels or springs.

The fauna of the channels may depend in great measure upon the growth of a fringing zone of *Ceratophyllum*. The fauna was meagre; a few Entomostraca, Hemiptera and cyprinodont fishes occurring, with *Anopheles* larvæ in the quieter bays. In the wetter parts of the swamp gastropod molluscs were numerous, a number of different species being present, including one species very similar to *Ancylus*. A prawn, the crab *Potamos* and the turtle *Clemmys* were common.

It is not within the scope of this article to describe the fauna of the drier part of the swamp, for it takes on a much more terrestrial facies: spiders, Lepidoptera, Orthoptera, etc., making their way in from the surrounding country. Mention may, however, be made of the numerous earthworms, which must have a very considerable modifying influence on the peat soil.

It is believed that the comparatively poor fauna of the swamp is due to the great fluctuations in the water-level and to the high carbon dioxide content and low oxygen content of the water. All these factors have been shown to be physiologically of great importance to the majority of animals.

The scope of the expedition was limited by the number of the personnel; and certain groups were perforce omitted from the collections. The objects of the work were to investigate the flora and fauna for forms of Ethiopian origin, to study in particular the plant ecology of a papyrus swamp, and to describe the distribution of such animals as were found. We hope that the material collected may throw fresh light on the problem of the origin of the Jordan Valley fauna.

Our thanks are due to the Hebrew University of Jerusalem for the valuable help they gave us, in particular to Dr. G. Mer, of the Malaria Research Station, Rosh Pinna.

[1] T. Barrois, "Contributions à l'étude de quelques lacs en Syrie". *Rev. Biol. du Nord France*, vol. 6.
[2] J. Hornell, "Report on the Fisheries of Palestine".

Mellon Institute of Industrial Research

DR. E. R. WEIDLEIN, the director of the Mellon Institute for Industrial Research, Pittsburgh, has published his twenty-third Report to the trustees. The Institute, established in 1913, was the material outcome of Prof. Robert Kennedy Duncan's system of industrial fellowships started in the University of Pittsburgh two years before. Since 1911, there have been 1,085 industrial fellowships on 268 technological subjects, and more than 500 new or improved processes and products have resulted, recorded in nearly 2,000 contributions to scientific literature. The Report claims with truth that the 363 fellows and 414 assistants who, having completed their fellowships, have entered the fields of manufacture, commerce and education constitute a most valuable gift. To celebrate the silver jubilee, a new building is under construction.

In the year ended March 1, 1936, the total sum of 632,546 dollars was received by the Institute from companies and associations for the creation of fellowships to defray the cost of scientific investigations; and the total contribution during the full period of twenty-five years is 10,662,091 dollars.

The Report for 1935–36 under review records the production in the laboratories during the year of an opal glass, two marble products, a group of refractories, several series of organic compounds, a synthetic resin, a specialty paper, an alloy steel for safety-razor blades, and several waterproofing agents for open fabrics. Physical methods for determining the character and amount of suspended solids in the air are progressing, the spectrograph and X-rays having been used to study ashed specimens of lungs. The Department of Research in Pure Chemistry, in co-operation with local hospitals, has investigated cinchona alkaloids, especially in relation to pneumonia. Some of these products cause serious visual trouble. Hydroxyethylapocupreine has given encouraging results. Patents have been obtained for some of these products "to ensure proper production and distribution". There is hope as the result of another research of producing anti-pneumococcic and anti-streptococcic sera.

During the calendar year 1935, 10 bulletins, 22 research reports and 58 other papers were issued from the Institute; 34 U.S. patents and 78 foreign patents were obtained. The record for the twenty-five years is 18 books, 132 bulletins, 726 research reports, 1,081 articles, and 617 U.S. patents. These statistics afford eloquent and incontrovertible evidence of the success of the scheme of industrial fellowships and reflect great credit on its organisers.

The present writer having had the privilege of attending the birth of the Mellon Institute derives special pleasure in expressing the congratulations of NATURE on the completion of twenty-five years working of the industrial fellowship system in the University of Pittsburgh. The idea came to life so long ago as 1906, when Duncan was attending the International Congress of Applied Chemistry in Rome; a year later, he established the first industrial fellowship in the University of Kansas, and in May 1907 published particulars of the scheme in the *North American Review*. The work, as already stated, commenced in Pittsburgh in 1911, and two years afterwards the brothers Andrew Richard and Richard Beatty Mellon, by a gift of half a million dollars, placed it on a permanent basis.

I first heard of the scheme when visiting the Canadian universities in 1910, as a preliminary to the first Congress of the Universities of the Empire, held in London in 1912. Discussing with Prof. H. R. Lang of the University of Toronto the urgent need for establishing *liaison* between the universities and industry if Great Britain were to survive the coming war, whether economic or martial, I was informed of Duncan's scheme and that Duncan, himself a patriotic Canadian, had offered to establish his scheme in that University. He met with refusal, and Pittsburgh secured what Toronto could not accept. In 1913, as Mitchell Student of the University of London, I investigated the work under Duncan's tutelage both in the University of Kansas and the University of Pittsburgh; and published the results in a Board of Education Pamphlet (No. 30; August 1915), and in an article in the *Quarterly Review* (October 1915). NATURE and other scientific and lay journals gave publicity to the scheme; but, possibly owing to preoccupations of the Great War, not much interest was displayed by universities or industries.

In 1915, the Government, recognising the urgency of the problem, published a "Scheme for the Organization and Development of Scientific and Industrial Research" which opened with the encouraging statement: "There is a strong consensus of opinion among persons engaged both in science and in industry that a special need exists at the present time for new machinery and for additional State assistance in order to promote and organise scientific research with a

view especially to its application to trade and industry".

It was declared in the scheme that "a great part of all research will necessarily be done in Universities and Colleges". In the first report of the Committee of the Privy Council (for 1915–16), signed by the chairman, Sir William McCormick, there was a full and admirable discussion of the problem referred to the Committee, which examined with restrained enthusiasm the possibility of establishing special research institutes in universities. The time, in any event, would have been unpropitious for the adoption of the policy of promoting industrial research in universities and colleges. Since the Great War, however, conditions have changed. There has been a prodigious increase in the number of university graduates capable of undertaking scientific and industrial research; a great development of industries based on science, assisted, without question, by the limitation of German and other foreign competition; and a quickened sense that science in alliance with industry must help to solve the problem of unemployment. These conditions are favourable for an experiment on the basis admirably demonstrated by the Mellon Institute of Industrial Research.

T. Ll. HUMBERSTONE.

Obituary

Prof. Karl Pearson, F.R.S.

WITH Prof. Karl Pearson, who died suddenly on April 27, has passed one of the great figures of the last half-century in science. He was born in 1857, son of William Pearson, K.C., of sturdy Yorkshire stock. Educated first at University College School, he entered King's College, Cambridge, as a scholar in 1875, and took his B.A. (Mathematical Tripos, 3rd Wrangler) in 1879; he was elected a fellow of the college in the following year, and remained a fellow until 1886. In 1882 he was called to the Bar in the Inner Temple, and originally intended to make the law his profession. But Sir Alexander Kennedy persuaded him to give up law and, to use his own expression, "finally landed me in Clifford's chair of Applied Mathematics at University College"—the Goldsmid professorship of applied mathematics and mechanics in the University of London. This was in 1884. He was the spiritual, not the direct, successor to Clifford, who had died in 1879; the post had in the meantime been held by Prof. Henrici.

In this chair Pearson lectured not only in the varied subjects required by candidates for University of London degrees in arts and science, but also gave lectures to engineering students, with accompanying classes in the drawing office, on graphic methods applied to mechanics, the determination of stresses in structures and so forth. There was, I believe, no similar course held in any British engineering school at that time, except possibly by Prof. Henrici at the then Central Technical College. During these early years, Pearson completed and edited, at the request of the syndics of the Cambridge University Press, Todhunter's "History of the Theory of Elasticity" (1886–93), the request having apparently been made to him, as he stated in some recent recollections (*Math. Gazette*, Feb. 1936), owing to Todhunter having incorporated in his MSS. a portion of one of Pearson's papers for a Smith Prize.

Pearson had been keenly interested by the work of Francis Galton and his statistical ideas, and felt that here was a new field for mathematical treatment and advance. Measurements on crabs made by his colleague Prof. Weldon presented an initial problem, and his first statistical paper was communicated to the Royal Society in October 1893 under the title "Contributions to the Mathematical Theory of Evolution", words used afterwards in the altered form "Mathematical Contributions to the Theory of Evolution" as a general title to many other memoirs. This paper dealt with the problem of dissecting a frequency distribution which could be assumed to be compounded of two normal frequency curves, and is important not only for its special subject but also for the introduction of the method of moments. This was followed in December 1894 by the second memoir, "Skew Variation in Homogeneous Material", developing his now well-known system of frequency curves, and by the third in September 1895 on "Regression, Heredity and Panmixia", developing the theory of correlation with special reference to heredity.

The memoir by Pearson and Miss Alice Lee (June 1897) "On the Distribution of Frequency of Barometric Height, etc." forms an interlude on a practical application; but with the fourth of the "Evolution" series (October 1897) "On the Probable Errors of Frequency Constants", written in conjunction with L. N. G. Filon, then his demonstrator but afterwards his successor in the chair, the first stage in the development of the Pearsonian *corpus* of statistical theory may be said to have been completed—frequency distributions, correlation, probable errors had all been given a first consideration. Truly astounding is the mass of work that followed, the more so when one remembers that it was not until 1911, when the Eugenics Record Office and its staff under Prof. Pearson's supervision had been already for some years in existence, that the will of Francis

Galton made possible the endowment of the Galton professorship of eugenics, of which he inevitably became the first holder and with which his name is now chiefly associated; not until then was he able to drop the immense burden of lecturing necessitated by the duties of the Goldsmid chair. The first number of *Biometrika* was issued in October 1901, and it has now completed a nominal twenty-seven but actually twenty-eight volumes; a mere glance through the tables of contents will show how largely Pearson's own contributions bulk therein. But memoirs were still contributed to the *Phil. Trans.*, the *Phil. Mag.*—contributions to that magazine including the notable and much discussed paper on testing goodness of fit—and elsewhere; and there was a whole host of Eugenics Laboratory Publications, as well as Drapers Company Research Memoirs; the Biometric Series, "Studies in National Deterioration", "Tracts for Computers", and "Questions of the Day and of the Fray". 'K.P.' was a born fighter, and the vigour of his onslaught not unnaturally led to retaliation in kind and consequent heat; but any bitterness generated and not already dissipated by the passing years will not survive his death.

The "Technical Series" of laboratory publications also ought not to go without mention: the memoirs on stresses in hooks, on masonry dams, on metal arches and other subjects, witness to Pearson's continued interest in elasticity notwithstanding the new line of work. Of his scientific works in volume form, the "Grammar of Science" (1883 and later editions) exhibits admirably the originality and logic of his thought and the clarity of his exposition. "The Chances of Death and other Studies in Evolution" (1887) is an amazingly varied collection of essays on subjects as diverse as death, roulette, sociology and folk-lore. Finally, there is the monumental "Life of Francis Galton", the finest tribute that could have been paid by the first holder of the chair to the founder whom he so honoured and loved. Though it scarcely falls within the category of his scientific writings, no one who wishes to know the man can neglect "The Ethic of Freethought" (1887, 1901), a collection of essays on history, philosophy and sociology.

Little more than two years ago Pearson described himself as "an adventurous roamer", and the phrase fits the man whose subjects ranged from Maimonides and the Veronica portraits of Christ to elasticity and statistics, and who could say: "In Cambridge I studied Mathematics under Routh, Stokes, Cayley and Clerk Maxwell—but wrote papers on Spinoza. In Heidelberg I studied Physics under Quincke, but also Metaphysics under Kuno Fischer. In Berlin I studied Roman Law under Bruns and Mommsen, but attended the lectures of Du Bois Reymond on Darwinism. Back at Cambridge I worked in the engineering shops but drew up the schedule in Mittel- and Althochdeutsch for the Mediæval Languages Tripos." The earliest contributions to the columns of NATURE that I have traced—and he was a not infrequent contributor in older days—are a letter (February 9, 1882) on the similarity of descriptive adjectives applied to colours and sounds, and a second (July 24, 1884) on apparently intelligent behaviour by a jay! The variety of his work is as striking as its mass. Only a scion of such vigorous stock could have produced it, or could have continued producing to the end of so long a life.

No old pupil of his will ever forget the lucidity and originality of Pearson's lectures; as another of them has written in *The Times*, he was no text-book teacher. In point of fact, neither for the matter of his lectures to engineers nor for his lectures on statistics, in the early days at least, were there any text-books. His early students in statistics—and I have no reason to suppose that matters altered afterwards—often had the privilege of listening to the first tentative steps in work which afterwards took shape in memoirs. It is sometimes said to the disadvantage of a non-resident university that there is little intercourse between teacher and taught, and little influence of the teacher beyond the classroom walls. Any such statement would be quite untrue of 'K.P.'; intercourse there was, the influence of his arresting and dominating personality went far beyond the classroom, and his tireless enthusiasm was infectious. Many of the makers and users of statistical methods all over the world to-day have been his pupils; more have learnt from his published work, and others again, as the years passed, have been pupils of his pupils.

Prof. Pearson was elected to the fellowship of the Royal Society in 1896, and awarded the Darwin Medal in 1898. In 1903 he was elected an honorary fellow of King's College, Cambridge. He was an honorary LL.D. of St. Andrews, an honorary D.Sc. of London, and an honorary member of the Anthropological Societies of Paris, U.S.S.R. and Washington. In the Galton chair, which he resigned in 1933, he was succeeded by Dr. R. A. Fisher, but his son Dr. E. S. Pearson was appointed to a new professorship of statistics.

G. UDNY YULE.

THE death of Prof. T. Terada on December 31, 1935, has deprived Japanese science of one of its most active and useful students. Born of a noble family in Tokyo on November 28, 1878, he studied experimental physics in the Imperial University of that city. In 1909, he received the degree of doctor of science, and in the following year left for a course of two years' training in cosmical physics in Europe and America. In 1916, he was appointed professor of physics in the Imperial University. He was one of the principal founders of the Earthquake Research Institute. Though, for more than twenty years, he suffered from serious illness, Terada's scientific memoirs are very numerous and cover a wide range of subjects, including seismology, oceanography, meteorology, terrestrial magnetism, etc. They are now being collected by a committee of friends and former pupils, and, when published, will fill about twenty volumes. Of scarcely less value, however, was the advice that he gave to his friends and students, who bear cordial witness to this assistance in many a memoir published in the *Bulletin* of the Earthquake Research Institute.

News and Views

Sunspots and Wireless Fade-Outs

ATTENTION may be directed to a coincidence between a fade-out reported by the B.B.C. as having taken place between 16^h50^m and 17^h00^m U.T. on April 8, 1936, and a large sunspot, just visible to the naked eye, which was observed crossing the central meridian of the sun at about that time. It should, of course, be understood that there is not a one-to-one correspondence between fade-outs and sunspots, any more than there is between large terrestrial magnetic storms and large sunspots. An extremely useful report entitled "Quatrième Rapport de la Commission pour l'Étude des Relations Entre les Phénomènes Solaires et Terrestres" has recently been issued by the Conseil International des Unions Scientifiques, which gives a number of short articles dealing with relations between various pairs of solar and terrestrial phenomena. The subject is an extremely tangled one, as both magnetic storms and wireless phenomena show some correlation with the solar rotation period, without showing a strict one-to-one correspondence with any recognisable solar feature. It will be remembered that Greaves and Newton found a stronger correlation between the strongest storms and spots than they found between moderate magnetic storms and moderate spots. The magnetic activity shows, as is well known, in addition to the 11-year sunspot period, a well-marked twenty-seven day recurrence (the period being that of the solar rotation) as do, of course, the spot numbers, but a period of intense magnetic activity is not necessarily one of marked spot activity.

A CONNEXION between radio fade-outs and eruptions of bright hydrogen has been looked for recently. For example, a fade-out in the United States on August 30, 1935, coincided with the central passage of a bright hydrogen eruption, both being repeated on October 24, but as R. S. Richardson remarks, it must be emphasised that Mt. Wilson Observatory has photographs of much larger and more brilliant outbursts with no apparent terrestrial effects. A recent coincidence of this nature was described at the February meeting of the British Astronomical Association, but Mr. Greaves emphasised the necessity of accumulating data rather than attempting to establish a correlation on a few such coincidences. The disturbances in the magnetic elements and the fade-outs are alike attributed to changes in the ionosphere, and it is now supposed, following the results of the 1932 eclipse, that the earth's upper atmosphere is ionised by ultra-violet radiation from the sun; indeed, in order to account for certain features of the ionosphere, Prof. M. N. Saha, at a recent meeting of the Royal Astronomical Society, offered the suggestion that the lines in the extreme ultra-violet solar spectrum (of wave-length about 1000 A.) are emission lines and not absorption lines. If the ionosphere is only affected by very short wave-lengths, the correlation lies between terrestrial phenomena and *extreme* ultra-violet solar activity, the latter being unfortunately unobservable, as the ozone layers cut off this region of the solar spectrum before it reaches the surface of the earth. As to the detail of Saha's suggestions, whether the far ultra-violet lines are emission lines or not (it is hoped to test this matter by observations made in balloons at a height of 30 km.) the facts so far as they are known, particularly the 27-day recurrence of the fade-outs and magnetic activity, suggest very strongly a connexion between terrestrial activity and the far ultra-violet activity, the correlations between terrestrial activity and other solar phenomena being of a secondary character.

England to South Africa Flights

MRS. MOLLISON completed her flight from Cape Town to London by the East Coast route (see NATURE, May 16, p. 821) on May 15, when she landed at Croydon at 1.36 p.m.; her time for the flight was 4 days 16 hours 17 minutes, which is more than a day and a half better than the previous record. The time for flying from England to southernmost Africa and back has thus been reduced to eleven days, three of which were given to rest in Cape Town. This flight, in a Percival 'Gull' aeroplane with a De Havilland 'Gipsy Six' engine, inspires an interesting examination of the technical development of air travel since the first flight between London and South Africa was accomplished. The pioneer flight was made by Wing-Commander H. A. Van Ryneveldt in a Vickers Vimy, two Rolls Royce engines of total 750 horse-power, taking 45 days, early in 1920. The increase of speed that primarily has made this possible comes from progress in aerodynamic design in reducing resistance that absorbs horse-power in overcoming it, and improvements in engine design, both in efficiency giving low fuel consumption and reduction of weight per horse-power. Thus, it has been possible to increase the air endurance of the average aeroplane, giving longer flight stages between stops for refuelling.

IMPROVEMENTS in instruments, radio direction finding equipment and such aids to navigation have helped in keeping the pilot to the shortest distance between the landing places, thus avoiding time wasted through losing the way, particularly after dark. In this case the development of ground organisation has played an equally important part. Facilities for refuelling, general servicing of the machine and such attentions, now normally available all along the route, have further helped to avoid delays. This does not, of course, detract from the magnificent feat of endurance, both physical and mental, of Mrs. Mollison. The actual time record for this route was made

by Squadron Leader Gayford and Flight-Lieut. Nicholetts in a Fairey monoplane, with a Napier engine, in February 1933. This flight finished at Walvis Bay, only just short of Cape Town, taking 2 days 9 hours 25 minutes. This machine was specially built and equipped for experimental long-distance non-stop flights, and was not entirely a practicable proposition for average everyday flying.

Science in a Changing World

THE Friday evening discourse at the Royal Institution on May 22 was delivered by Sir Richard Gregory, editor of this journal, who took as his subject "Science in a Changing World". Every week the correspondence columns of NATURE include announcements of new experiments and observations carried out by the authors in various parts of the world. Since its foundation by Sir Norman Lockyer in 1869, this journal has been the recognised medium for recording such advances in natural knowledge and for the discussion of scientific questions raised by them. Each volume of the hundred and thirty-six which have been published contains noteworthy communications of this kind, and a few of them were mentioned in the discourse. A new era in the history of physical science began just forty years ago. Within a few months, the discoveries were announced of argon, helium, X-rays and radioactivity. It was in the columns of NATURE that Lord Rayleigh first directed attention to the differences of density between nitrogen obtained from the air and from chemical sources which led to the announcement in 1895 of the discovery of argon. Sir William Ramsay also announced there his extraction of helium from the mineral cleveite—twenty-seven years after it had been found by Sir Norman Lockyer in the sun.

THE first translation into English of Röntgen's paper "On a New Kind of Rays" was published in this journal, and also the first suggestion that cathode rays offered the most promising means of producing distant optical vision—now called television. It was in 1908 that Mr. A. A. Campbell Swinton described how cathode ray tubes might be used for this purpose; and his device has now been successfully developed for the transmission and reception of television programmes, such as will shortly be available from Alexandra Palace. Many scientific discoveries, however, have not added to the amenities of life but to its degradation. Sir Richard Gregory urged, therefore, that it has become the duty of men of science to adjust themselves to the conditions of a changing world, and to take an active part in promoting worthy uses of scientific discoveries and preventing the application of new forces to purposes of destruction.

Freud and the Anthropologist

To mark the occasion of Sigmund Freud's eightieth birthday on May 6, Dr. Géza Róheim, perhaps the most distinguished, and certainly the most experienced exponent of the application of Freud's theories to field investigation in anthropology, evaluates in *Man* of May his master's contribution to the principles of research among primitive peoples. It is interesting to note that Dr. Róheim, pointing to the fact that the anthropologist's criticism of Freud has been directed mainly against his version of the 'primitive horde' or Cyclopean family, does not himself believe that psycho-analytic anthropology stands or falls with this view of human origins. This is explained in part by Dr. Róheim's general position. Not only does he hold that Freud's minor papers would explain certain problems to the anthropologist, if the anthropologist would only grasp these explanations; but also he maintains that the real significance of Freud for the anthropologist does not lie in his contributions to anthropology. The explanation of the apparent paradox is that he stresses Freud's technique as his greatest contribution to the science. In the employment of psycho-analysis he has elaborated a method to explain personality. If, as is now admitted on an overwhelming mass of evidence, this method is valid as applied to Europeans, we must believe a priori that it is applicable at least as a method of investigation to savages, the fundamental psychological unity of mankind being taken for granted. Further, he goes on to point out, as a matter of practice it has been abundantly demonstrated that the dreams of primitive people can be analysed according to the same method and with the same results as the dreams of Europeans. Finally, perhaps the most important point in relation to understanding of the method, Dr. Róheim indicates in response to criticism from the 'functional' school, how and in what sense the term 'neurosis' is not merely individual, but is to be taken as applicable to the group.

U.S. National Academy of Sciences: New Members

THE following have recently been elected to the U.S. National Academy of Sciences: Prof. Leo H. Baekeland, honorary professor of chemical engineering in Columbia University; Prof. Eliot Blackwelder, professor of geology in Stanford University; Prof. I. S. Bowen, professor of physics in the California Institute of Technology; Dr. Wallace H. Carothers, research chemist in E. I. du Pont de Nemours and Co.; Prof. Alexander Forbes, associate professor of physiology in Harvard University; Prof. W. F. Giauque, associate professor of physical chemistry in the University of California; Prof. Clark L. Hull, professor of psychology in Yale University; Prof. Edwin O. Jordan, chairman of the Department of Bacteriology at the University of Chicago; Dr. A. V. Kidder, chairman of the Division of Historical Research of the Carnegie Institution; Prof. Warren H. Lewis, research associate of the Carnegie Institution and professor of physiological anatomy in Johns Hopkins University; Prof. Robert S. Mulliken, professor of physics in the University of Chicago; Prof. W. C. Rose, professor of physiological chemistry in the University of Illinois; Prof. Edmund W. Sinnott, professor of botany in Columbia University; Prof. J. L. Walsh, associate professor of mathematics in Harvard University; Dr. Orville Wright, known for his pioneer work on the aeroplane.

Excavations at Armant, 1935-36

IMPORTANT discoveries are announced in the report of the expedition of the Egypt Exploration Society to Armant, which has been at work in Upper Egypt since last autumn under the direction of Mr. Oliver Myers. The expenses of the expedition were borne entirely by Sir Robert Mond. It had three objectives. Of these the first was unsuccessful. A fortnight's search failed to find graves containing the Saharan pottery, of which sherds are found scattered on the low desert. The settlements and graves of these people seem to have weathered away; but it is probable that they visited Egypt before the known Pre-dynastic periods. The second object was to investigate the origins of the combed burnished pottery closely resembling Badarian. This proved to belong to an intrusive people of the Proto-dynastic period. More than a hundred graves were opened, and although the top of the cemetery had been removed and the contents disturbed, so that no object of intrinsic value was retrieved, what remained was of the greatest interest. The people were small, and may have been of two distinct races. Possibly they practised bull-worship, for the more important members of the tribe were buried with their cattle. The oxen were crouched in pear-shaped graves facing the main burial. The pottery had the incised chevron pattern around the rim; and some showed the incised white decoration found on the Nubian pots of the Middle Kingdom. Agate lunates hafted to form arrows resemble those from the tomb of the wazir of Den of slightly later date.

THE expedition's greatest success, however, was achieved in the town, where the site of Cleopatra's lake was discovered without difficulty. A hollow filled with green putrid water in the middle of the town, still sacred as having curative properties, soon showed on excavation the walls, preserved to within two or three metres of the original surface, with a stairway leading down one side. Dressed stones in the *suq* square proved to be part of a pylon of Tothmes III, celebrating his victories over the Nubians. Among other representations of his spoils is the first known example in Egyptian art of the rhinoceros, its capture being described on a neighbouring stela. Among other notable finds are a record of two additional *set* festivals of Rameses II, and a cubit divided duodecimally, antedating the supposed introduction of this method of division by the Greeks by a thousand years.

Zoological Society of London

THE 107th annual report of the Zoological Society of London for 1935 submitted to the annual meeting on April 29 contains records of the breeding of more than fifty species of mammals, twenty birds and five reptiles at Regent's Park, and twenty-seven species of mammals and seven of birds at Whipsnade. The pathological report records that out of an average population of 824 mammals and 1,631 birds, 215 mammals or 26 per cent, the lowest for the past ten years, and 539 birds or 33 per cent, died and were examined by the department. Injuries and accidents accounted for 183 or 20·2 per cent of the deaths, digestive diseases for 142 or 15·6 per cent, and respiratory diseases for 138 or 15·2 per cent. Two monkeys, two antelopes, a wild pig, a hedgehog and a desert cavy died of tuberculosis; twenty-one birds and a reptile of mycosis; nineteen mammals, five birds and three reptiles of rickets and bone diseases; two mammals and thirty-five birds of urinary diseases; seven mammals, twenty-four birds and two reptiles of blood and circulatory diseases. Eight of the birds died of old age, including a snowy egret which had lived nearly fifteen years in the Gardens, and an Indian kite which had lived there more than fourteen years. Four mammals, including the rare okapi, ten birds and nine reptiles died from parasites. A new elephant house to replace the 1869 building is to be completed by 1937, while original ideas to be carried out at Whipsnade include open air collections of chimpanzees and gibbons on islands with growing trees; as these apes will not cross water, visitors will be able to watch them without intervening bars. In a Studio of Animal Art, to be built near the Society's offices, living models of lions, tigers and other creatures will be available for classes of up to twenty-four students.

Present State of Bird-Ringing in Britain

IT will be interesting to see if the number of wild birds ringed in 1935 for migration study in the British Isles, namely, 46,430, the first decline for many years, 1934 having 49,651, approaches the limit of work possible for field ornithologists working without financial assistance from official bodies. Of the leading ringers, Dr. H. E. Moon, of Cumberland, marked 5,205 birds (1,762 song-thrushes, 970 lapwings, 877 blackbirds, 379 starlings and 154 swallows), and excepting 1934, he has marked more birds than any other ornithologist each year since 1924 (*British Birds*, April 1936). Since bird-ringing began in Great Britain under the organisation of H. F. Witherby in 1909 (when 2,171 birds were marked), 482,510 birds have been ringed, chiefly nestlings; but the proportion of adult birds is increasing with the use of small 'traps' and bird-observatories, last year's totals including 30,364 nestlings and 16,066 'trapped' birds. Of the total number of birds ringed since marking began, the leading figures are: song-thrush 53,108, blackbird 42,469, starling 37,592, swallow 34,243, lapwing 27,928, chaffinch 19,684, greenfinch 18,643, redbreast 17,008, common tern 15,245 and black-headed gull 12,902, Sandwich tern 11,630, hedge-sparrow 11,317, house-marten 9,996, willow-warbler 8,492, linnet 7,659, yellow bunting 3,953. The proportion of recoveries is not always the same, and out of 3,037 spotted flycatchers marked, only seven have been recovered, only one out of 1,092 garden-warblers, and one out of 625 grey wagtails, while out of 1,337 arctic terns marked, two have been recovered, and out of 8,492 willow-warblers three have been reported. In some species the recoveries reached 23 per cent.

Institute of Physics

THE annual general meeting of the Institute of Physics was held on Tuesday, May 19. After election of the officers and completion of the panel of the Board, it was announced that the following would take office on October 1, 1936: *President*, Prof. A. Fowler; *Vice-President*, Mr. F. Twyman; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Colonel K. W. E. Edgcumbe and Prof. R. Whiddington. The annual Report for the year 1935 which was adopted at the meeting shows that membership has continued to increase and that the high standard required for corporate membership has been maintained. The total membership at the end of the year was 822. The first Industrial Physics Conference to be held in Great Britain took place in Manchester in March 1935, and the attendance was nearly 550. The subject of the Conference was "Vacuum Devices in Research and Industry", and an exhibition of instruments, apparatus and books cognate to the subject was arranged and was open to the public. Some 3,500 people visited the exhibition. A Midland Local Section was inaugurated in November, the towns covered being Birmingham, Leicester, Nottingham and Rugby. The Report shows that the scheme for the training and certificating of laboratory assistants has developed satisfactorily and 21 certificates were issued during the year. The Institute's services in placing employers in touch with physicists seeking permanent posts and with consultants were in constant demand throughout the year. The circulation of the *Journal of Scientific Instruments* increased during the year, both on account of the commencement of its distribution to 'associates' without extra payment and on account of sales to non-members.

The Education of Naval Architects

AT the recent meeting of the Institution of Naval Architects, Mr. L. Woollard gave an account of the methods of training naval architects in Great Britain to-day in Admiralty establishments, at the universities and at the various technical colleges. As is well known, the Admiralty more than a century ago took the lead in technical education, and the work of the schools in the dockyards, at South Kensington and Greenwich, has been reviewed at various times by Sir William White, Sir William Smith and Sir Arthur Johns. To-day, however, there are courses for degrees in naval architecture at the Universities of Glasgow, Durham and Liverpool, while there are no fewer than seventeen technical schools or colleges in England and Scotland where courses can be followed for the National Certificates in Naval Architecture. These certificates are awarded by a Joint Committee of the Institution of Naval Architects and the Worshipful Company of Shipwrights, in conjunction with the Board of Education or Scottish Education Department. Mr. Woollard gives particulars of the courses followed at the R.N. College, Greenwich, and elsewhere, the scholarships open to students and a list of papers and articles in the education of naval architects. When referring to Admiralty training, he says that experience has shown that candidates have more difficulty in satisfying the examiners in mathematics than in the other subjects, and students weak in mathematics find great difficulty in keeping pace with the courses at Greenwich.

Uniformity as the Gauge of Quality

IN a paper read to the Institution of Electrical Engineers on May 1, Mr. C. C. Paterson pointed out that there is always a tendency to judge a manufactured product by its showing one desirable feature rather than from its uniformity. He said that with certain exceptions, such as the laws of gravity, there is a remarkable absence of uniformity throughout Nature. There is a tendency to admire extremes, such as the tallest mountain or the longest river. This explains why there is a certain distrust in the pursuit of uniformity. The engineer is rather apt to take it for granted. Much attention is paid to class-testing, but the same effort is not made to ensure that every product is up to the level of the class tested. In the case of electric boiling plates, for example, if the supply voltage is 6 per cent low the consumption of energy compared with the heat developed is increased 14 per cent. Variations such as these are superimposed on the manufacturers' permissible limits of variation now called 'tolerances'. Fifteen years ago, the manufacture of glass was largely a matter of rule of thumb methods, with the result that in making lamps about 150 bulbs were used for every 100 lamps. When an effort was made to obtain glass of uniform quality with the desired characteristics, only 104 bulbs were used for each 100 lamps produced. In the early days of dry battery manufacture, great stress was laid on individual output. With the growing use of multicellular batteries, where failure of any unit meant failure of the whole battery, attention was concentrated on securing uniformity, with the result that the failures now are of the order of five in a million. In conclusion, Mr. Paterson dwelt on the importance of using frequency curves when assessing the deviation of products from the standard. Instead of using tolerances, it would be much better to adopt the coefficient of variation or the standard variation from the frequency curve by the method used by statisticians.

Influence Lines

IN the analysis of beams and girders it is possible by the method of influence lines to simplify the process of determination of the stresses due to the passage of a system of rolling loads. In such cases the preparation of diagrams of maximum bending moment and shear force is usually a laborious matter; whereas it is eminently simple to construct a bending moment influence diagram which, for a particular section, will show the bending moment at that section due to a load of one ton placed at any point in the beam. For the given section the one diagram serves each and every load, but while the use of influence lines is generally referred to in structural engineering text-books, the special technique required in their applica-

tion to a given problem and their interpretation receives little or no attention. There is now available, however, a handbook ("The Application of Influence Lines to the Stress Analysis of Beams and Lattice Girders." By R. McCrae. Part 1. Pp. 42. (London : The *Draughtsman* Publishing Co., Ltd.) 2*s*.) which discusses fully their practical uses as they might be of advantage to a designer. The first part, which is now issued, deals with beams only. The author's primary object in Part 1 has been to provide the reader with a knowledge of the fundamental principles underlying the conception of influence lines. He shows how simple it is to construct the diagram for all cases and how the maximum effects due to rolling and distributed loads can be deduced. In the matter of units, it would have been an advantage to have described the ordinate of the bending moment influence line as representing ton-foot units per ton, so that when multiplied by the appropriate load the result is rational. Those who have been in the habit of using the bending moment diagram will at first find the influence line somewhat unorthodox but, once masters of the system, will doubtless agree as to its advantages, particularly in saving time and eliminating errors, and will appreciate the detailed treatment given in this publication.

A Clarity Tester for Gelatine

THE introduction of the various forms of rectifier photo-electric cell has certainly simplified many problems in the use of instruments such as colorimeters (chemical type), densitometers and the like, since currents of the order of 100 microamperes can be attained without very intense light, the cell acting, when suitably illuminated, as a primary source of direct current without the use of batteries. Many such applications have now been developed. A convenient instrument of this type has been recently designed by Messrs. Imperial Chemical Industries, Ltd., and put on the market by Messrs. Baird and Tatlock (London), Ltd., for the testing of the clarity of gelatine and other aqueous solutions. It is well made and easy to operate, and should be found of great assistance in saving time in such tests as well as in giving much better accuracy than visual comparisons. No doubt more or less empirical scales would have to be established for particular types of product, and in instruments of this kind (as indeed in visual photometry) it will be important to avoid confusion between scattering and direct absorption of light.

Butane Gas Supply in Rural Areas

IN an article in *Engineering* of May 8, Mr. Theodore Rich gives an account of the development of the use of bottled butane gas in rural areas with no gas or electricity supply in France, the United States and Great Britain. Butane (C_4H_{10}) can be obtained from natural gas, crude oil or coal; it liquefies under a pressure of 23 lb. per sq. in. at 60° F. At a temperature of 104° F. the pressure of liquefaction is only 62 lb. per sq. in., and it can therefore be delivered to customers in comparatively light steel bottles. In France the bottles contain 28·6 lb. of liquefied gas, which has a heat content of 21·590 B.Th.U. per lb. The cost works out at about 3*s*. a therm. It is distributed by several thousand agents, and the gas is used particularly for cooking, one bottle containing sufficient gas to cook for a family of three persons for six or seven weeks. At the Paris Fair of May 1935, practically every maker of gas stoves showed apparatus for the use of butane. The manufacture of butane and isobutane in Great Britain has been undertaken by Imperial Chemical Industries, Ltd., at Birmingham, and the gas is being marketed as 'Calor' gas. Butane can be used for gas fires, geysers and for house lighting, and in the villages of Smalldole in Sussex, Stokesley near Middlesbrough and Hay in Brecknockshire, it has been applied to street lighting.

Solid *v*. Liquid Fuels

IT is one of the characteristics of our times that science and technical effort make us largely independent of geographical circumstances. Products not occurring naturally may be synthesised, and under the plea of national self-sufficiency much may be done, even although entirely uneconomic when judged by former standards. Many things can be done with liquid fuel which are difficult or impossible with solid, and the natural result has been the development of the oil industry. The latest phase is the synthesis of liquids from coal by hydrogenation, and the technical merit of this achievement is apt to obscure the economic aspect. There are, however, still those who insist on the reversion to old standards, and a pamphlet issued by the Liberty Restoration League, 24 Essex Street, London, W.C.2, makes a plea for the return to coal and its products in place of oil for all purposes. It is claimed that the use of liquid fuels on land, sea and air is largely maintained by subsidy, open or concealed, which should be recognised and even curtailed. Much of the plea cannot be gainsaid, but neither the State nor the individual is likely to forgo powers conferred by liquid fuels. There is much to be said for greater efforts to transfer coal into products now in demand, but it is wholesome that the cost should be clearly understood.

Institute of Wireless Technology

THE annual general meeting of the Institute of Wireless Technology took place on April 30. Mr. James Nelson was elected president for the ensuing year and Mr. B. Tunbridge Hogben was re-elected hon. treasurer. The annual report showed a further increase of membership, and in particular it was noted that the student membership had increased to a greater extent in 1935 than in any previous year. The number of candidates for the associateship and associate membership examinations also showed an increase for the year under review. It should be mentioned that the subject of television has been included as a special subject for several years past, and this is believed to be the only examination for television engineers to be held by any professional institution in the country. The presidential address was entitled "The Value of the Institute to the Profession and Industry".

Royal Aeronautical Society Anniversary Exhibition

A SPECIAL exhibit, which has been formed by the Royal Aeronautical Society to mark the seventieth anniversary of its foundation, was inaugurated in the Science Museum, South Kensington, on the occasion of the Society's annual reception on May 21, and will be available to the public until June 22. The exhibit comprises aeronautical objets d'art, aeronautical trophies, medals, engravings, stamps and rare or unique articles connected with ballooning and aviation, many of which have been lent by private collectors. The Society will show the first Council Minutes (January 12, 1866) and MSS. relating to outstanding events in its history; the first pilot's certificate issued in Great Britain and granted to Lieut.-Col. J. T. C. Moore-Brabazon—now president of the Society—will be included.

Scientific Instruments in Relation to Textiles

DURING Whit-week, the Textile Institute is holding its annual Conference in London, and in association with this event, it has been arranged to hold an exhibition of apparatus, and testing devices for scientific and industrial research in relation to textiles. The exhibits will be staged at the headquarters of the Conference, the Hotel Victoria, Northumberland Avenue, London, W.C.2. The exhibition will be opened by Dr. Harry Moore, director of research of the British Scientific Instrument Research Association, at 3 p.m. on June 3, and remain open until 9 p.m. On June 4 and 5 the exhibition will be open from 10 a.m. to 7 p.m. The exhibits will include a ring wool friction testing machine; whirling-light rotoscope; hygrometers; thermographs; recording pyrometers, pressure gauges, trichromatic colorimeter; microscopes; time regulators; ultra-violet equipment; X-ray apparatus; colour comparators; spectrophotometers; colloid mills; and devices for controlling and recording temperature, humidity and pressure. A descriptive catalogue of exhibits will be issued free to all visitors. Further particulars and tickets of admission are available from the Textile Institute's headquarters at 16 St. Mary's Parsonage, Manchester 3.

Gift to the Royal College of Surgeons

A GENEROUS donation of £25,000 has been made by the Bernhard Baron Trustees to the Royal College of Surgeons for the erection of new research laboratories. This gift will, by the provision of additional and up-to-date facilities at the College, give a further impetus to research on problems of surgical interest. A research institute for surgery in the centre of London will provide opportunities for those interested to carry on their investigations under the best possible conditions. In this way, the College will have in the future an increased share in the maintenance of London's reputation as one of the great centres of surgical treatment and research.

Medal Awards at the Franklin Institute

AT a meeting of the Franklin Institute, Philadelphia, on May 20, the following medal awards were made: *Franklin Medals* to Dr. Frank Baldwin Jewett, vice-president of the American Telephone and Telegraph Company and president and director of the Bell Telephone Laboratories, for his many important contributions to telephony alone and in collaboration with other workers in the great laboratory of research which he has directed with such signal success, and to Dr. Charles Franklin Kettering, vice-president and director of the General Motors Corporation and general director of the General Motors Research Laboratories, Detroit, for his contributions to the science of automotive engineering; *Elliott Cresson Medals* to Dr. George O. Curme, jun., of Carbide and Carbon Chemicals Corporation, New York City, for his work on synthetic aliphatic compounds based upon the olefines as starting material and their use in industry, and to Dr. Robert J. Van de Graaff, of the Massachusetts Institute of Technology, for his development of an electrostatic generator for the production of high-voltage direct currents; *Edward Longstreth Medals* to Dr. Alfred V. de Forest, president of the Magnaflux Corporation, New York City, associate professor at the Massachusetts Institute of Technology; Major William E. Hoke, consulting engineer, Baltimore, for his work on a method of detection of hidden defects, primarily at or near the surface of magnetic materials; Peter P-G. Hall, president of the Hall Planetary Co., Philadelphia, for his invention and development of machine and cutters for planetary milling and threading; Elmer A. Sperry, jun., vice-president of Sperry Products, Inc., Brooklyn, N.Y., for his development of blind-flying instruments employing gyroscopic principles; *John Price Wetherill Medal* to Albert L. Marsh, president of the Hoskins Manufacturing Co., Detroit, Michigan, makers of electric furnaces, pyrometers and resistance wire; *Walton Clark Medal* to Dr. Joseph Becker, of the Koppers Construction Company, Pittsburgh, Pa., for his improvements in the art of carbonisation of coal and manufacture of gas in coke ovens, and particularly for his work in the development of the oven known as the 'Becker Oven'; *Louis Edward Levy Medal* to Mayo D. Hersey, of Brown University, for his papers on the theory of lubrication, published in the June, July, August and September issues of the *Journal* of the Institute for 1935; *Howard N. Potts Medal* to Dr. Felix A. Vening Meinesz, Amersfoort, Holland, professor of geodesy and geophysics at the University of Utrecht, for his work in geodesy, and for the development and use of apparatus for determining gravity at sea.

Announcements

SIR ROBERT HADFIELD has been elected a foreign member of Group 1 (Mathematical and Natural Sciences) of the Norwegian Academy of Sciences and Letters. This group of the Academy is limited to 110 Norwegians and 100 foreigners; among the latter are Sir William Bragg, Sir Frederick Gowland Hopkins, Lord Moynihan, Lord Rutherford, Sir Napier Shaw, Sir Grafton Elliot Smith and Sir J. J. Thomson.

THE honorary gold medal of the Royal College of Surgeons has been awarded to Dr. J. A. Murray "in appreciation of his services as director of the laboratories of the Imperial Cancer Research Fund". Mr. R. B. Wade, president of the Royal Australasian College of Surgeons, has been elected into an honorary fellowship of the College.

DR. ALBERT DEFANT, professor of oceanography and geophysics at the University of Berlin, has been elected a foreign member of the Swedish Society of Anthropology and Geography, and has been awarded the Galathea Medal of the Royal Danish Geographical Society of Copenhagen.

AT a council meeting of the Royal Aeronautical Society held on May 12, Mr. H. E. Wimperis, director of research in the Air Ministry, was elected president for the year 1936–37. At the same meeting, Mr. F. Handley Page was elected a vice-president of the Society for the year 1936–37, and Major T. M. Barlow was re-elected vice-president for a further year of office.

PROF. A. KOPFF, professor of theoretical astronomy in the University of Berlin, will deliver the George Darwin Lecture at the ordinary meeting of the Royal Astronomical Society on Wednesday, June 10, taking as his subject "Star Catalogues, especially those of Fundamental Character."

DR. C. MONTAGUE COOKE, jun., malacologist on the staff of Bernice P. Bishop Museum, has been elected corresponding member of the Natural History Museum, Vienna, in recognition of his publications and work in assembling materials and records relating to Pacific land snails.

MR. H. J. PAGE has been appointed to succeed Lieut.-Col. B. J. Eaton, who is retiring shortly from the post of director of the Rubber Research Institute, Malaya. Mr. Page, who is at present controller of agricultural research at the Agricultural Research Station maintained by Imperial Chemical Industries, Ltd., at Jealotts Hill, will be leaving England for Malaya in July next.

ON the occasion of the visit to Bath on May 16 of the Section of the History of Medicine of the Royal Society of Medicine, Sir D'Arcy Power unveiled a memorial tablet of John Hunter on the wall of 12 South Parade, where Hunter lived in 1785, and Dr. F. G. Thomson delivered an address on some early Bath physicians and their times.

PROF. E. V. APPLETON will deliver three lectures on "Some Problems of Radio Communication" in the Fyvie Hall of the Polytechnic, Regent Street, London, on Thursdays, June 11, 18 and 25 at 6.30 p.m.

THE following appointments have recently been made by the Secretary of State for the Colonies: W. F. Steven, to be plant pathologist, Agricultural Department, Gold Coast; J. M. W. Ware, to be veterinary officer, Department of Animal Health, Gold Coast.

THE German Society of Natural Science and Medicine will hold its annual Congress at Dresden on September 21–24.

A SCHOOL for Sanitary and Social Education was opened on March 7 at Prague at the expense of the State, supported by the Rockefeller Foundation.

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

A tutor in mathematics in Loughborough College, Leicester—The Registrar (May 25).

A teacher of engineering in the Technical College, Walthamstow—The Clerk to the Governors, 263 High Street, Walthamstow, E.17 (May 25).

A lecturer in mechanical engineering (aerodynamics and aircraft design) in the Coventry Technical College—The Director of Education, Council House, Coventry (May 28).

A teacher of mathematics in the Northern Polytechnic, Holloway, London, N.7—The Clerk (May 29).

An assistant lecturer in engineering in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (May 30).

A junior scientific officer in the Wood Chemistry Section of the Forest Products Research Laboratory, Princes Risborough, Aylesbury—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 30).

A demonstrator in botany in Westfield College, London, N.W.3—The Principal's Secretary (June 1).

An assistant lecturer and research worker in physiology in King's College, London—The Secretary (June 2).

Technical assistants (physics or engineering) at the Signals Experimental Establishment, Woolwich Common, S.E.18—The Superintendent (June 2).

Civilian technical officers (physics or engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote *C.E.* 2915/36) (June 6).

An assistant lecturer in geology (specially qualified in stratigraphy and palæontology) in the University of Birmingham—The Secretary (June 6).

A research assistant for investigation of the mackerel fisheries at the Marine Biological Laboratory, Plymouth—The Principal (June 10).

A lecturer in zoology in Armstrong College, Newcastle-upon-Tyne—The Registrar (June 13).

A mining engineer under the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, Westminster, S.W.1 (June 16).

A lecturer in physics in the Heriot-Watt College, Edinburgh—The Principal.

An assistant in the Intelligence Section of the Plant and Animal Products Department of the Imperial Institute, South Kensington, S.W.7—The Establishment Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 872.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Induced Radioactivity of Short Period

CRANE, Delsasso, Fowler and Lauritsen[1] have reported the existence of radioactive bodies of periods less than a second formed by bombarding lithium or boron with deuterons. They assume the active isotopes to be ^{8}Li and ^{12}B. It might be possible to produce these and perhaps other radioactive nuclei of short period by neutron bombardment, and it was thought desirable to investigate this question by means of a suitable arrangement.

The experiments were performed with an apparatus very similar to that used by Frisch in a search for similar effects produced by α-particles[2]. The neutron source (beryllium–radon) is placed 75 cm. from a thin-walled Geiger counter which is shielded from the direct beam by a 70 cm. bar of lead and from scattered radiation by surrounding with 8–10 cm. of lead. The semi-cylindrical samples of the elements to be examined are held by an arm, and can be swung from a position around the neutron source to a position around one side of the counter in 0·3 sec., the arm passing through a suitable slit in the lead shield. The movement is controlled by a pendulum the period of which can be changed from 1 sec. to 2–4 sec. Such an arrangement is suitable for the examination of induced radioactivity of period greater than 0·3 sec. With a neutron source of initial strength 350 millicuries, the following results were obtained :

Beryllium. Strong activity of half-value period $0{\cdot}9 \pm 0{\cdot}2$ sec. (determined by means of about three hundred oscillograph records of the decay). The effect is reduced to half when the β-rays pass through 0·4 gm./cm.^{2} aluminium, indicating that their maximum energy is of the order of $6\text{–}8 \times 10^6$ e.v. The yield is of the same order as the yield from calcium fluoride bombarded with neutrons when the samples have equal thickness in gm./cm.^{2}; for example, the rate of counting during the counting period was about 400 per minute with a source of 130 millicuries, the γ-ray effect being 40 per minute. Surrounding the source with paraffin wax does not increase the effect.

The process leading to the active nucleus might be capture of the neutron by the ^{9}Be nucleus with the emission of a γ-quantum, two neutrons, a proton, a deuteron or an α-particle, the active nucleus being ^{10}Be, ^{8}Be, ^{9}Li, ^{8}Li or ^{6}He, respectively. ^{10}Be can probably be excluded on account of reliable knowledge of the masses of ^{10}Be and ^{10}B, which are very nearly equal[3]. ^{8}Li is excluded if the active body found by Crane *et al.*[1] is ^{8}Li, for they found a β-ray spectrum with an upper limit of 10×10^6 e.v., which means that the neutrons bombarding ^{9}Be would have to have an energy of some 13×10^6 e.v., assuming the masses given by Oliphant[3]; the beryllium–radon source does not yield such fast neutrons in quantities sufficient to explain the large effect found. It is difficult to decide between the other possibilities so long as the β-ray spectrum of the active body is not known. Experiments with an expansion chamber are intended. But it can be said that if the maximum energy is greater than $5{\cdot}5 \times 10^6$ e.v., the active body can scarcely be ^{6}He, as its mass would then be greater than that of ^{4}He plus two neutrons.

Other elements. The following elements have been examined, but no new activities have so far been found : Li, B, C, N, O, F, Na, Al, Cl, Fe, Ni, Cu, Zn, Se, Ag, Cd, Sn, Pb. Knol and Veldkamp have reported a weak activity induced in lithium by slow neutrons[4], but their experimental conditions (rotating wheel, counting lasting many hours) are difficult to compare with those of the present work.

I wish to thank the Technical Highschool of Denmark for a grant and the Radium Station for the gift of the emanation.

T. BJERGE.

Physical Laboratory,
Technical Highschool of Denmark,
Copenhagen.
April 30.

[1] Crane, Delsasso, Fowler and Lauritsen, *Phys. Rev.*, **47**, 887 and 971 (1935).
[2] O. R. Frisch, NATURE, **133**, 721 (1934).
[3] Oliphant, NATURE, **137**, 396 (1936).
[4] Knol and Veldkamp, *Physica*, **3**, 145 (1936).

Collision Forces between Light Nuclei

IN the interpretation of experiments on anomalous scattering in terms of a field departing from the inverse square law at the closer distances, it has been usual to use, in the absence of evidence to the contrary, only forces of short range corresponding to e^2/mc^2. We are of the opinion that, if the current method of explanation is to be retained, forces of longer range must also be admitted. We have measured the angular distribution of scattering of the slower α-particles in hydrogen, deuterium and helium under similar conditions. Our calculations indicate that for all three gases the forces would have to act at distances greater than 10×10^{-13} cm., although they need not be large until smaller separations are reached. The reason is, briefly, that in all cases the higher 'phase-constants' are important, so that even those particles which approach less closely can penetrate the anomalous region. We are grateful to Dr. J. A. Wheeler for informing us that he had also reached this result, independently, for helium.

It is perhaps worth noting that even in the collision of two elementary particles such as proton on proton, long-range forces may also be of importance. White[1], in discussing his experiments on the scattering of fast protons in hydrogen, is able to reach only a partial explanation with short-range forces of attraction. We have made approximate calculations using the field described by Infeld[2], and find that this gives a large enough negative phase-constant K_0 to account for the two main features, the large anomaly

at 45° and its rather rapid variation with energy. The calculated values are intermediate between White's and those of Tuve, Hafstad and Heydenburg[3], and as a qualitative explanation this seems as successful as that already given by Present[4] in terms of exchange forces. This is not strong evidence for Infeld's theory, since the main effect at these energies—up to 1,000 kv.—is due to the large repulsion at small distances near the critical radius r_0 ($1{\cdot}9 \times 10^{-13}$ cm.).

The interpretation of the scattering intensities by means of potential fields is not, moreover, incompatible with the existence of stable energy levels or of resonance levels which may be used in tentative models of compound nuclei, since the known binding energies and the phase-shifts of zero order can be reproduced with strong attractive forces at radii which need not exceed 2×10^{-13} cm. The binding energies are not greatly affected by introducing long-range forces as well.

Forms of potential field which will meet all of these requirements in detail must await further investigation.

C. B. O. MOHR.
G. E. PRINGLE.

Cavendish Laboratory,
Cambridge. May 5.

[1] *Phys. Rev.*, **49**, 309 (1936).
[2] *Proc. Camb. Phil. Soc.*, **32**, 127 (1936).
[3] *Phys. Rev.*, **49**, 402 (1936).
[4] ibid., **48**, 919 (1935).

Return of Radio Waves from the Middle Atmosphere

WE are glad to be able to confirm and amplify the indications given by Prof. R. C. Colwell and A. W. Friend in the letter which appeared in NATURE of May 9. One of us, in his address, as chairman, to the Wireless Section of the Institution of Electrical Engineers[1], has reported briefly on the initial stages of work for the Radio Research Board undertaken recently at Orfordness, a site the isolation of which permitted the use of substantial powers in short-duration pulses for the closer study of the lower regions of the ionosphere. In addition to the sporadic reflections from levels between 85 km. and 100 km. then reported, we have had under intermittent observation the very complex echo-systems which result from the return of radio waves from heights between 6 km. and 60 km.

We had, just before publication of the letter of Prof. Colwell and Mr. Friend, completed a preliminary communication on these studies, which we hope may be published at a very early date. Meanwhile we may say that we incline to recognise three distinct regions from which radio waves, up to very high frequencies, are returned within the range of height 6–60 km. The echoes from the lowest heights appear to belong to a system of multiple reflections from sharply defined heights which usually lie above 6 km., are not infrequently found at 10 km., and on a single occasion have been found so high as 14 km.

A second and apparently independent group of echoes returns from levels between 15 km. and 50 km., and we show in our forthcoming communication that this region is almost certainly replenished by local thunderstorms. The thunderstorm mechanism is probably involved also in the replenishment of the lower region, but much further study is necessary before the evidence about these two regions is unravelled; this remark applies, with perhaps greater force, to a third region which we recognise at about 60 km. This third region does not appear to be very closely related to either of the other two; it cannot, for example, be dismissed as a misinterpretation of second-order echoes from the 30 km. region.

Our work, which began in May 1935, and in which heights were first measured with some certainty on June 10, 1935, has been carried on to complete a year's observation, mainly in the frequency range 6–12 mc./sec.; in some isolated trials on notably higher frequencies—including those proposed for television services—we have not yet attained a frequency so high that its return from the middle atmosphere can be regarded as unusual.

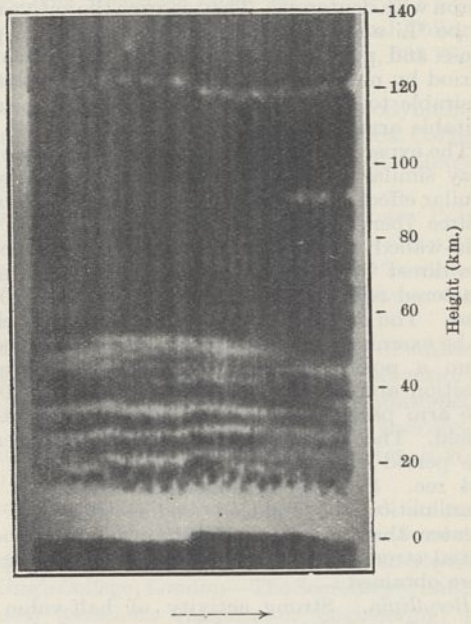

FIG. 1.

The accompanying illustration (Fig. 1) is a direct untouched reproduction from a continuous record of equivalent path against time ($P't$); the portion reproduced covers two minutes in time near 0700 G.M.T. on July 5, 1935, and shows echoes, on a 6 mc./sec. frequency, which includes, in addition to the ground ray response and the known E-region echoes, a series of multiple reflections from the low heights now under discussion, together with echoes at intermediate heights which cannot, we suggest, be fitted into one or two simple series of multiple reflections.

This work has been undertaken as part of the programme of the Radio Research Board and this note is published by permission of the Department of Scientific and Industrial Research.

R. A. WATSON WATT.
L. H. BAINBRIDGE-BELL.
A. F. WILKINS.
E. G. BOWEN.

National Physical Laboratory,
Teddington, Middlesex.
May 14.

[1] *J. Inst. Elec. Eng.*, **78**, 10 (1936).

PROF. COLWELL and Mr. Friend[1] state that from results of experiments conducted by them they have been led to believe that, besides the usual *E* and *F* regions of the ionosphere, there is a third region—the *D* region—at a height of 5–55 km. They further say: "Such a layer has been postulated before as an absorption layer in the ozone region, but its reflecting powers have not been emphasised".

I would like to point out in this connexion that the formation, during daytime, of a region of ionisation much lower than, and distinct from, the usual Kennelly-Heaviside region has already been postulated by us, both from the consideration of the weakening and complete disappearance of *E*-echoes on the long wave-length side due to absorption by this region (as compared with that due to penetration on the short wave-length side) and from the evidence of echoes which have been detected by us from an equivalent height of about 55 km.[2,3]. These points, as well as the condition under which reflection may take place from such low heights, have been amplified and discussed by Mr. P. Syam, working under my direction[4]. The possible connexion of this ionised region with the ozonosphere—though this latter is now known to be at a height much lower than 55 km.—has also been mentioned. I may also add that Mr. J. N. Bhar, working in my laboratory at Calcutta, has recently reported having observed echoes from heights much below 55 km.

Prof. Colwell and Mr. Friend believe they have obtained echoes from well within the tropospheric regions. It is doubtful if such echoes, if they were observed, were due to the same mechanism as envisaged by the Eccles-Larmor theory. At such heights the collisional frequency is very high, and, for the wave frequency employed by these authors, an enormous electron concentration is necessary to bring down the effective dielectric constant to a zero value. Such high degree of ionisation, if it existed, could scarcely have been missed by those who carry out direct observations in these regions by aeroplanes or balloons.

It should be noted here that, according to English workers, the weakening of *E*-echoes, during daytime, is due to absorption in a non-deviating region (as distinguished from the deviating region of maximum electronic density at a higher level) of the Kennelly-Heaviside layer[5]. The ionised region postulated by us at a much lower height—which under suitable conditions reflects radio-waves—is distinct from this region. To avoid confusion I propose that this new region of ionisation be called the *C* region.

S. K. MITRA.

London.
May 9.

[1] R. C. Colwell and A. W. Friend, NATURE, **137**, 782 (1936).
[2] S. K. Mitra and P. Syam, NATURE, **135**, 953 (1935).
[3] S. K. Mitra, "Report on the Present State of our Knowledge of the Ionosphere", *Proc. Nat. Inst. Sci. India*, **1**, 131 (1935).
[4] P. Syam, *Ind. J. Phys.*, **10**, 13 (1936).
[5] F. T. Farmer and J. A. Ratcliffe, *Proc. Roy. Soc.*, A, **151**, 370 (1935).

Technique of the Painting Process in the Brihadesvara Temple at Tanjore

WHILE scientific investigations into the technique of the methods of production of the mural paintings in the Palace of Minos at Knossos, in Pompeii, etc., have been conducted by Noel Heaton[1], Eibner[2], Berger[3], Raehlmann[4] and others, very little has been done in this direction in the East. With the exception of the work on the Ajanta frescoes[5], of which, however, details of investigations are not available, nothing has been done to reconstruct the exact methods of production of ancient paintings in India, and compare them not only with the methods suggested in Indian texts on painting, but also with those adopted in the West in ancient times.

Recently, I had occasion to study the technique of the painting process adopted in the Brihadesvara temple at Tanjore in South India, in connexion with proposals for their conservation. Of the two groups of paintings in this temple, the earlier one is in the Ajanta or the 'classical' style of Indian art, and is important, since it is the only perfect specimen extant in India of the Hindu art of classical painting.

The paintings are executed on the walls of the dark passage surrounding the main shrine of the temple. The walls are built of large blocks of hornblende-gneiss and over them has been spread the lime plaster for the beautiful 'classical' paintings dating from about the twelfth century A.D., and belonging to the Chola period of Indian history. Over this, and completely covering it, is another loosely bound layer of paintings of about the seventeenth century A.D., which was executed during the days of the Nayaks of Tanjore. The latter group of paintings is cruder than the Chola group in technique and style and forms a type of 'folk' art.

The technique adopted in the execution of these paintings is fresco, no binding material having been used with the pigments. It represents a continuation of the older painting processes in India. From the different samples of painted stuccoes examined so far, the Chola paintings are in *fresco-buono* technique and the Nayak in *fresco-secco* technique. The stuccoes are almost alike in both these cases. They are composed of the *Rinzaffo*, a first rough coat of lime plaster, followed by the *Intonaco*, a second coat of fine lime plaster with pigments thereon. Their approximate thicknesses are given in the accompanying table:

Thicknesses of the Different Layers in the Stuccoes

	Chola	Nayak
Entire stucco	2·64 mm.	2·35 mm.–3 mm.
Rinzaffo	1·84 mm.	1·52 mm.–2·17 mm.
Intonaco	0·67 mm.	0·63 mm.

The results of analyses of the Chola and the Nayak stuccoes are as follows:

	Chola stucco		Nayak stucco	
	Rinzaffo	Intonaco	Rinzaffo	Intonaco
	Per cent	Per cent	Per cent	Per cent
Moisture	0·38	0·23	3·14	3·77
Silica, SiO_2	49·97	7·02	63·39	13·76
Iron and Alumina, $Fe_2O_3 + Al_2O_3$	1·89	1·06	3·69	1·59
Carbon Dioxide, CO_2	18·05	25·13	9·38	23·67
Sulphuric anhydride, SO_3	0·26	0·58	0·17	0·59
Magnesia, MgO	0·51	0·37	0·33	1·02
Lime, CaO	27·88	65·59	18·56	55·58
Undetermined (mostly alkalis)	1·05	*nil*	1·34	*nil*
	99·99	99·98	100·00	99·98

Except sand, nothing has been used as an inert material along with the lime.

So far as the pigments are concerned, lime has been used for the white; carbon for black; red, yellow and brown ochres as red, yellow and brown pigments;

lapis lazuli or ultramarine for blue and terre verte for green. Such colours as yellowish green, light blue and bluish green have been got by mixing yellow and green or yellow and blue, blue and white and blue and green respectively.

Fuller details of the investigations will be published in a suitable journal.

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March 5.

[1] Tiryns II, Die Ergebnisse der Ausgrabungen des Inst., Kaiserlich Deutsch. Arch. Inst. in Athen 1912, pp. 211–217. "Minoan Lime Plaster and Fresco Painting", *R.I.B.A. Journal*, **18**, 697 (1911).
[2] "Entwicklung und Werkstoffe der Wandmalerei vom Altertum bis zur Neuzeit".
[3] "Die Maltechnik des Altertums".
[4] "Über die Maltechnik der Alten".
[5] Arch. Survey of India, Ann. Reports, 17, Part 1, 6–7 (1916).

Raman Spectra of 'Heavy' Arsine, Silicichloroform and Silicibromoform

CONTINUING the study of pyramidal molecules, we have measured the Raman lines of light and heavy arsine. These substances were prepared in the usual way, by means of sodium arsenide and water. The measurements give :

	ω_1	ω_2	ω_3
AsH_3	2094	990	910
AsD_3	1508	730	630

ω_1 and ω_3 correspond to the single frequencies; ω_2 to the double one.

We have also measured the Raman lines of heavy silicichloroform and silicibromoform ; these are :

	ω_1	ω_2	ω_3	ω_4	ω_5	ω_6
$DSiCl_3$	1647	252	489	555	—	179
$DSiBr_3$	1616	167	360	468	—	114

ω_1, ω_2, ω_3 correspond to the single frequencies, ω_4, ω_5, ω_6 to the double ones.

Complete discussion of these results will be published elsewhere later.

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Detection of Spotted Wilt Virus in Chrysanthemums

SPOTTED WILT of tomato, first recorded in Great Britain by K. M. Smith[1] in 1931, is now prevalent in the country, and is especially troublesome and difficult to control in gardens and 'mixed nurseries', where a variety of plants are grown, on account of the wide host range of the virus and the efficiency of its insect vector, *Thrips tabaci*. Control measures have to be directed towards the extermination of the insect vector and the destruction of infected plants, so that the detection of the virus in those perennial plants able to act as reservoirs from which the virus may be introduced into successive crops is often a matter of considerable importance.

Chrysanthemums are known to be susceptible to spotted wilt, and in several instances there has been strong circumstantial evidence that outbreaks of spotted wilt have originated from infected stocks of chrysanthemums. Unfortunately, the symptoms of spotted wilt in chrysanthemums, though at times well defined and recognised by characteristic ring and line patterns on the leaves, are usually rather indefinite and mild, and considerable difficulty has been experienced in detecting the virus in chrysanthemums, even in plants known to be infected. Observations and experiments made in the summer of 1935 and during the last few weeks have given a partial explanation of the failure to detect the virus of spotted wilt in chrysanthemums.

The addition of an extract of healthy chrysanthemum leaves to an extract of spotted wilt infected tomato leaves was found to inactivate the virus. For example, an extract of chrysanthemum leaves was prepared by grinding one part by weight of fresh leaves with two parts of distilled water and expressing the liquid through muslin. In the same way a preparation was made from spotted wilt infected tomato material, and divided into two portions. To one portion an equal volume of water was added, and of six tomato seedlings inoculated six developed symptoms of spotted wilt, and seventy-eight local lesions developed on four tobacco leaves inoculated, while no trace of infection resulted in similar numbers of tomato seedlings and tobacco leaves inoculated with the second portion to which an equal volume of chrysanthemum leaf extract had been added immediately before use.

Chrysanthemum leaf juice darkens rapidly on exposure to air, and it was thought that oxidising enzymes or the products of oxidation might be responsible for the inactivation of the virus. Bald and Samuel[2] showed that the virus of spotted wilt is sensitive to oxidising agents and that although certain reducing agents hasten inactivation, the activity of the virus in tomato juice is greatly prolonged in the presence of sodium sulphite. An extract of chrysanthemum leaves prepared with a 0·5 per cent solution of anhydrous sodium sulphite remains green for several days and does not immediately inactivate the virus when added to infected tomato juice. In one experiment the numbers of local lesions produced on eight tobacco leaves by portions of the same virus preparation diluted with equal parts of 0·5 per cent sulphite solution, sulphite chrysanthemum leaf extract and aqueous leaf extract were 152, 41 and 2 respectively.

A number of leaves were taken from a spotted wilt infected chrysanthemum and cut into halves longitudinally. One set of halves was ground up with 0·5 per cent sulphite solution, and sixteen lesions developed on the six tobacco leaves inoculated, while no lesions developed on the parallel series of leaves inoculated with the water extract prepared for the remainder of the material.

By this method it has been possible regularly to detect the virus in chrysanthemums from which previous attempts had been unsuccessful or inconclusive, and it is possible that the use of sodium sulphite might facilitate the detection of spotted wilt virus in other hosts or in plants in which the concentration of virus had fallen to a low level.

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[1] K. M. Smith, NATURE, **127**, 852 (1931).
[2] J. G. Bald and G. Samuel, *Ann. Appl. Biol.*, **21**, 179–90 (1934).

A Case of Lethal Genes in the Horse

THE only case of a lethal gene in the horse described hitherto was by Yamane[1] in Japan; it produced a blind large intestine, which caused colic and death among the new-born foals sired by one Percheron stallion. The following case, which I have observed in the well-known Polish stud of half-breed horses at Skrzydlów, p- Aurelów, near Częstochowa, is therefore of interest, because its explanation is analogous to that of Yamane's case mentioned above, although perhaps more complicated.

The Anglo-Arab stallion Menzin (Polish St. B. V. I., p. 204) covered in 1933 seventeen mares; in 1934, nine foals sired by Menzin were born, of which six were quite normal and three showed a peculiar lameness of one or both forelegs. The new-born foals could not stand at all and, of course, it was necessary to destroy them. In the following year (1935) thirteen foals were sired by Menzin: of these nine were normal and four were cripples. In neighbouring stud-farms, where Menzin also covered some mares, four foals sired by him were born; three were normal and one cripple.

It should be stated that, before 1934, when the mares at Skrzydlów were served by other stallions, they never produced cripples.

The legs of the crippled foals were examined and no signs of rickets or any other bone disease have been found. The lameness consisted in a marked bending of the leg in the region of the phalanges, with an undeveloped hoof. Somewhat analogous with this is the case of inherited crooked fingers in new-born children described by Mohr[2].

A detailed report in a genetical journal will follow.

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[1] "Biological Essays on the Horse", 1929, p. 39. Berlin.
[2] "Über Lethalfaktoren", *Z. ind. Abst. u. Ver. Lehre*, 1926.

Mutations arising at the Bar Locus in *Drosophila melanogaster*

THE Bar mutation has been investigated by Sturtevant (1925–26), Dobzhansky (1928) and others. However, so far two very important lines of inquiry have remained obscure in the Bar problem: (1) What is the cause of the occurrence of Bar mutation *de novo*; and (2) what is the nature of Bar mutations caused by irradiation with X-rays?

Hanson (1928) has shown that Bar mutations arise in males exposed to X-rays. By exposing males to X-rays we obtained a great number of Bar mutations (1 : 382); for example, complete reverse mutations, feebler and stronger allelomorphs of Bar, some of which were lethal, others sterile. A cytogenetic study of the salivary nuclei has shown that out of thirty-four cases studied, in seventeen the occurrence of the Bar mutation was connected with an aberration. In ten of these cases one break occurred exactly at the Bar locus (Fig. 1); in six cases, some distance from Bar; and in one case there was a deficiency which included the Bar locus. It is noteworthy that among the complete reverse mutations studied, only one aberration among ten was connected with a break at a distance from Bar; whereas in the seven cases of incomplete reverse mutations (infra-Bar and ultra-Bar types), five breaks occurred some distance from Bar.

In the majority of cases the complete reverse Bar mutations are not connected with a loss of this locus. They are not manifested phenotypically, however, when they are heterozygous for Bar, appearing as homozygous Bar. On the other hand, the reverse mutations retained completely the mutational potentialities of Bar. When reverse mutations were exposed to X-rays a great number of Bar mutations were obtained (1 : 928) which were all connected with chromosome aberrations. The eight cases studied cytologically were all connected with a break of the *X*-chromosome at Bar.

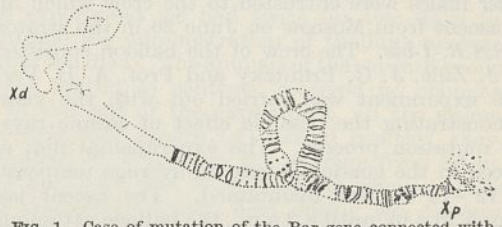

FIG. 1. Case of mutation of the Bar gene connected with aberration at the Bar locus (inversion).

The X-irradiation of double Bar showed unexpectedly a lower frequency of Bar mutations and a disproportionately frequent simultaneous mutation of both Bar genes, producing an allelomorph without phenotypic manifestation (double reverse Bar but not deficiency as Demerec thought). Finally, it was shown that half of these mutations occur in connexion with chromosome aberrations—of fourteen cases six were without aberrations and eight were connected with breaks at the Bar locus.

FIG. 2. A region of the *X*-chromosome from the nucleus of a salivary gland cell of a heterozygous fly (double-Bar *X* Normal). The insertion of double Bar is detectable in region 16 A.

Taking into account Sturtevant's investigations and Wright's considerations, we investigated Bar cytologically. In the females heterozygous for Bar, an insignificant non-coincidence of chromosomes at the Bar locus was found. A study of the heterozygotes for double Bar (E. N. Volotov) has shown the presence of insertions at the Bar locus (Fig. 2). Consequently, all the known occurrences of Bar mutations *de novo* are connected with disturbances of the chromosomes at the Bar locus (the case of Tice which was studied cytologically by us, baroid of Dobzhansky, the two Bar mutations of Muller, and one Bar mutation discovered by Dubinin and Goldat, unpublished).

The mutational changes of the Bar gene induced by X-rays are in many instances caused by the effect of the position of this gene on its manifestation.

The Bar mutations occurring *de novo* are also caused by the effect of the position of the genes at the Bar locus (see also Dobzhansky, 1932).

A study of the occurrence of Bar mutations under the action of X-rays shows that the breaks at the Bar locus occur more frequently than Bar mutations *de novo* (if the greater frequency of breaks in the Bar chromosome are not caused by the presence of the Bar gene itself). Hence, for the occurrence of Bar *de novo* not only a break of the chromosome at the Bar locus is necessary but also an attachment of some other specific material as well.

A comparison of the mutational process in Bar and double Bar leads us to suspect that the position effect changes the action of the gene as well as its mutational potentialities.

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Cosmic Rays and Mutations

THE following results have a bearing on the problem touched upon by Dr. Hamshaw Thomas in his paper "Cosmic Rays and the Origin of Species"[1].

In 1933 I had the idea of subjecting *Drosophila* flies to the action of cosmic rays in the stratosphere. However, it was only in 1935 that I was enabled to carry out my plan, and about 300 *Drosophila melanogaster* males were entrusted to the crew which made an ascent from Moscow on June 26 in the stratostat *U.S.S.R.-I-bis*. The crew of the balloon consisted of K. J. Zille, J. G. Prilutzky and Prof. A. B. Verigo. This experiment was carried out with the view of demonstrating the possible effect of cosmic rays on the mutation process. The experimental flies were placed in the gondola where an average temperature of 12°–14° C. was maintained. The ascent lasted from 5.25 a.m. until 8.2 a.m., the balloon attaining an altitude of 15,900 metres.

According to the data of Prof. Verigo, the experimental flies were for two hours under the action of cosmic radiation which in intensity exceeds cosmic radiation at the level of the ground on the average by 100 times. As soon as the flies landed safely they were studied genetically. The usual *ClB*-method for determining the lethal mutation which occurs in the *X*-chromosome of the sperm of initial males was adopted. At the same time we kept a control batch of flies of the same age and stock (counting 20 days from the egg stage, a wild stock of Nalchik, inbred for five generations).

The following results were obtained: in 2,724 chromosomes of the experimental flies, 8 mutations were obtained ($0{\cdot}294 \pm 0{\cdot}104$ per cent), whereas 2,445 chromosomes of the controls gave 10 mutations ($0{\cdot}409 \pm 0{\cdot}129$ per cent).

These negative results compel us to be circumspect in accepting theories which look upon cosmic rays as important factors in organic evolution.

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[1] NATURE, **137**, 51 (1936).

Photochemical Reaction of Chlorophyll with Ferrous Ions

A SHORT time ago, J. Weiss[1] described in NATURE some experiments on the photochemical bleaching of dyestuffs in presence of ferrous ions, and interpreted the bleaching effects as reduction-oxidation reactions between the excited dyestuff molecules and the ferrous ion, according to the equation

$$Fe^{++} + HOH + (D_s h\nu) = Fe^{+++} + OH^- + (D_s\text{-}H) \quad (1)$$

As dyestuffs he used brilliant-cresylblue, methyleneblue, thionine, uranine and chlorophyll.

I should like to point out some difficulties encountered if one tries to reproduce Weiss's experiments using chlorophyll as the photochemically active dyestuff.

Ferrous sulphate, it is true, exerts a bleaching action on chlorophyll, both in neutral and sulphuric acid solution, but this reaction is *not* influenced by irradiation. It is easy to prove this by adding a small quantity of solution of ferrous sulphate to a solution of chlorophyll in methyl alcohol and irradiating with a strong carbon arc after thoroughly removing the atmospheric oxygen (say by evacuating the vessel for a sufficiently long time). The irradiation causes *no change* of colour. The experiment gives the same result also when sulphuric acid is added[2]. But if atmospheric oxygen is not, or not thoroughly, removed, a rapid bleaching of the chlorophyll may be observed, and the solution takes an olive brown coloration, indicating that an oxidation product of chlorophyll has been formed[3].

It may be inferred from this evidence that the photochemical reaction between chlorophyll and ferrous sulphate does not take place according to the equation (1), and that it is not analogous to the photochemical reduction of the vat dyes. In view of the fact that this reaction takes place only in presence of oxygen, it may rather be regarded as a photochemical oxygen transfer, the ferrous sulphate acting as an acceptor. In this sense that reaction is in close analogy to the photochemical bleaching of chlorophyll in presence of thiosinamine and other organic acceptors[4]. Photochemical reactions of this description take place also in the absence of acceptors, for example, in absence of ferrous sulphate, but with an incomparably smaller velocity. Further results on the photochemical oxidation of chlorophyll will be published elsewhere.

With respect to Weiss's experiments with the other dyes referred to in his note, I described more than four years ago identical experiments on the bleaching of thionine in presence of ferrous sulphate and sulphuric acid[5]. The photochemical reaction between methylene blue and ferrous sulphate has been studied, moreover, by K. M. Brandt[6].

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March 16.

[1] J. Weiss, NATURE, **133**, 794 (1935).
[2] According to Willstätter and Stoll ("Assimilationsbuch", p. 226), chlorophyll is, moreover, destroyed by addition of acid.
[3] Cf. Willstätter and Stoll, l.c., p. 415.
[4] Cf. H. Gaffron and K. Wohl, *Naturwiss.*, **24**, 103 (1936).
[5] K. Weber, *Z. phys. Chem.*, B, **15**, 38 (1931); *Naturwiss.*, **23**, 849 (1935).
[6] K. M. Brandt, *Arkiv för Kemi*, **12**, No. 7 (1935).

Thermal Decomposition of Ethylene Oxide

THE thermal decomposition of ethylene oxide vapour was first studied by Heckert and Mack[1], who showed that the process has the essential characteristics of a kinetically unimolecular reaction. In many respects, however, their data were incomplete and the interpretations suggested rather unsatisfactory. We have recently made a detailed re-examination of the kinetics of the reaction. In view of recent discussion of the problem by several workers[2], it may be desirable to summarise now the results of our investigation, which although in general agreement with that of Heckert and Mack, is more complete.

We have measured the rate of the decomposition over the temperature range 435°–505° C.; that is, up to temperatures 70° C. higher than those used by Heckert and Mack, where the rate was very small. The use of the higher temperatures has both experimental and theoretical advantages. The products are predominantly carbon monoxide and methane, but hydrogen and ethane are also formed. The reaction is roughly 'first order over its course', but the velocity constant is noticeably dependent upon pressure, as found by Heckert and Mack.

A careful examination, however, of the manner in which the velocity constant varies with pressure over the range 15–800 mm. reveals the existence of a 'segmented' plot of $1/t_{1/2}$ against p_0. At 475° C. the 'period of half change' is almost independent of initial pressure with $p_0 > 250$ mm. Between *c.* 250 mm. and 40 mm. there is a 'bimolecular' relationship between $t_{1/2}$ and p_0, and below *c.* 40 mm. at least one other such 'bimolecular' region. In this respect, therefore, the reaction falls into line with other similar decompositions recently examined[3], and can be interpreted as involving the superposition of several independent quasi-unimolecular processes. The energy of activation of the reaction for $p_0 > 300$ mm. is *c.* 54,000 cal., and at the lowest pressures (*c.* 20 mm.) is somewhat lower (*c.* 50,000 cal.). The rate at the pressure at which the 'falling-off' is first manifest is in accordance with the postulation of a distribution of activation energy among about nine squared terms, which appears a more reasonable value than that previously calculated by Ramsperger[4].

Increase in the surface-volume ratio of the reaction vessel by about eight times at 470° C. lowers the rate by less than 10 per cent, which, allowing for possible errors, is scarcely significant. The existence of appreciably long reaction chains is therefore unlikely. It has been suggested that isomerisation to acetaldehyde is the first stage in this decomposition, even though no direct evidence for such a mechanism was obtainable. We have been unable to detect the presence of acetaldehyde among the reaction products at any stage of the decomposition over the temperature range employed.

Inert gases (argon, nitrogen, helium and others) retard the decomposition to some extent, but the precise details of this effect require a fuller explanation.

The detailed results will shortly be published elsewhere.

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[1] *J. Amer. Chem. Soc.*, **51**, 2706 (1929).
[2] NATURE, **136**, 909 (1935); *J. Amer. Chem. Soc.*, **58**, 534 (1936).
[3] *Proc. Roy. Soc.*, A, **141**, 41 (1933); A, **146**, 327 (1934).
[4] *Chem. Rev.*, **10**, 27 (1932).

Antagonistic Effect of Iodides in Baldness and Toxicity due to Thallium Acetate

IN earlier reports[1,2], we stated that potassium iodide administered subcutaneously prevents the loss of hair caused by thallium acetate, as well as reduces considerably the toxicity of the latter.

The object of the present investigation was to find out whether other salts of iodine have the same effect as potassium iodide. We used seven groups of rats, each group consisting of seven rats, except the sixth thallium group which had ten rats. The experiment continued for 69 days. The first four groups (*A*) were receiving daily *per os* for a period of 32 days 0·3 mgm. and for a further 36 days 0·4 mgm. of thallium acetate per 100 gm. weight. In addition, the animals of these four groups received daily subcutaneously 0·5 c.c. of lithium iodide, potassium iodide, sodium iodide and magnesium iodide, respectively (1 c.c. of iodide solution contained 20 mgm. of iodine). The animals of the fifth group (A_5), which were receiving daily the same quantity of thallium acetate *per os* as the previous four groups and also 0·5 c.c. of calcium iodide, very quickly developed dermatitis of the third grade due to the amount of calcium ion administered, and therefore we had to discontinue the calcium iodide. The animals of the sixth group (*B*), which served as controls to the five *A* groups, received *per os* thallium acetate only in the same quantity as the *A* groups. However, during the experiment the animals of Group *B* looked very ill, and in order to save some animals to the end of the experiment we had twice for two days to discontinue the administration of thallium acetate (six out of ten died). The animals of the seventh group (*C*), which served as controls, received no chemicals.

At the end of the experiment, all the animals of the first four groups (*A*) looked healthy, they had increased in weight on the average from 38 gm. to 135 gm. (two rats of the sodium group and one of the magnesium group died during the experiment) and preserved almost completely their coats; however, their hair was softer and lacked the lustre of normal hair. Also the two survivors of Group A_5, which received later on potassium iodide instead of calcium iodide, had the same appearance as the animals of the other *A* groups.

The surviving animals of Group *B* lost their hair almost completely; in a few places the lanugo was seen, and also the feelers were not affected. These animals developed stomatitis, erythema and eczema and at the end of the experiment they looked very poor. The most striking effect of thallium acetate was that all the survivors of this group developed cataracts and other eye defects after 35–50 days of administration of thallium acetate, and the animals became entirely blind. This was never observed in the rats of the *A* groups. Also their average weight showed a smaller increase (from 38 gm. to 115 gm.) and was below the weights of the animals which received the iodides.

The rats of Group *C* increased in weight on the average from 36 gm. to 195 gm. and looked entirely normal.

The results of this experiment indicate that lithium iodide, potassium iodide, sodium iodide and magnesium iodide prevent to a great extent the falling out of hair, reduce considerably the toxicity of thallium acetate and prevent the development of cataracts and other eye defects brought about by thallium acetate. The best results were obtained with lithium and potassium iodide; the results with sodium and magnesium iodide were a little less satisfactory. Calcium iodide would probably have the same biological action as the other iodides used in this experiment, but due to its deleterious effect upon the skin it cannot be used subcutaneously in such experiments.

These results are not in accordance with the results of some scientific workers[3], who state that potassium iodide does not act as an antidote to thallium (probably not in acute thallium poisoning); in our experiment we obtained satisfactory results with potassium and other iodides as antidotes in chronic thallium poisoning.

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April 2.

[1] Hykeš and Diakov, NATURE, **136**, 685 (1935).
[2] Hykeš and Diakov, *Publications biol. Ecole vétérin.* (*Biol. spisy V. š. zvěrolék.*) *Brno*, **14**, 85 (1935).
[3] Hesse, "Handb. exper. Pharmakol.", iii, Bd. 3, T., 2177 (1934).

The Harding Sugar Reagent

THE Harding[1,2] sugar reagent has recently been criticised by Van der Plank[3], who failed to reproduce Harding and Downs'[2] factor for glucose.

In our experience this is one of the most sensitive of the copper reagents and one of the most accurate if prepared from pure chemicals. We have easily and constantly reproduced the factors published by Harding and Downs with many different batches of reagent, and have found the factor for glucose not to vary from day to day over periods up to twelve months. It was found, however, that if chemicals of a grade inferior to AnalaR be used, inconsistent results may be obtained. For example, the use of ordinary quality anhydrous sodium carbonate resulted in an inferior reagent: the defect was at once remedied when anhydrous sodium carbonate of 'analytical' quality such as Shering-Kahlbaum's was used. We would suggest that Van der Plank's findings may be due to a similar cause.

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G. A. D. HASLEWOOD.
British Postgraduate Medical School.
G. A. GRANT.
Lister Institute.
April 17.

[1] *Trans. Roy. Soc. Can.*, Section v, **26**, 33 (1932).
[2] *J. Biol. Chem.*, **101**, 487 (1933).
[3] *Biochem. J.*, **30**, 458 (1936).

Ascorbic Acid as a Precursor of Serum Complement

MY experiences (unpublished) are in complete accord with those of Dr. F. Marsh[1].

Some years ago, when working in the Bacteriological Department, Trinity College, Dublin, I was responsible for carrying out weekly routine Wassermann reactions. During the winter months, I had found on several occasions that the serum of guinea pigs was very deficient in complement, and that most of the animals died after bleeding by intra-cardiac puncture. On one occasion the deficiency in complement appeared to be the prelude to an epidemic of pneumonia which swept off most of the stock.

On inquiry, I found that the animals had been receiving neither grass nor other fresh food, and on the addition of mangolds or cabbage to their diet the complement rapidly (within the course of the next week) rose to normal titres. It was interesting also to note that animals with a fresh diet rarely died from the effects of intra-cardiac puncture.

Owing to pressure of routine work, it was unfortunately not possible to carry out a quantitative investigation on this subject.

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April 21.

[1] NATURE, **137**, 618 (April 11, 1936).

Points from Foregoing Letters

AN arrangement for detecting induced radioactivity of short periods (greater than 0·3 sec.) is described by Dr. T. Bjerge. He finds in beryllium, after neutron bombardment, a strong activity of half-period 0·9 sec. and maximum energy of the order 6–8 × 10^6 electron volts.

From the angular distribution of scattering of the slower alpha particles by light and heavy hydrogen and by helium, C. B. O. Mohr and G. E. Pringle calculate that the forces which come into play would be active at distances greater than 10 × 10^{-13} cm. They conclude that, if the current method of explanation is to be retained, forces of range longer than e^2/mc^2 must also be included.

Three distinct electrical conducting regions in the middle atmosphere (6–60 km. high) from which radio waves up to very high frequencies are returned are described by R. A. Watson Watt, L. H. Bainbridge-Bell, A. F. Wilkins and E. G. Bowen. The lowest is usually at about 6 km. but sometimes at 10 km. and even at 14 km. The second region is at 15–45 km. and appears to be related to local thunderstorms. The third region is about 60 km. high. The existence of an electrically conducting region at a height of 5–55 km. was shown recently by Colwell and Friend; they proposed to call it the *D* region. Prof. S. K. Mitra directs attention to previous work by himself and his co-workers which indicated a conducting region at a height of 55 km., and states that recently Mr. J. N. Barr has observed echoes from heights much below 55 km. Prof. Mitra suggests calling the new region the *C* region.

G. C. Ainsworth reports that the addition of 0·5 per cent sodium sulphite to an extract of chrysanthemum leaf containing spotted wilt virus renders easier the detection of the virus (by inoculating tobacco leaves). Without the addition of sulphite the test is frequently inconclusive; this is due apparently to inactivation of the virus by oxidising enzymes or oxidation products present in chrysanthemum juice.

The cause and occurrence of reduction in the number of ocelli in the compound eye of the fruit fly under the influence of X-rays, and the related chromosome change, are discussed by Prof. N. P. Dubinin and E. N. Volotov. They report that new mutations of this type are connected not only with a break of the chromosome in the Bar region but apparently also with the attachment of some other specific material, since the number of mutations observed is smaller than that of the breaks, and other aberrations were also noticed.

An experiment on the possible effect of cosmic rays in producing lethal mutations in the *X*-chromosome of the fruit-fly is reported by Prof. H. Friesen. The flies were taken on the stratosphere flight of the *U.S.S.R.-I-bis*, and were subjected for two hours to a hundredfold greater intensity of cosmic radiation than control flies left behind. The result was negative.

The mechanism of the thermal decomposition of ethylene oxide vapour has been a recent subject of discussion. A more detailed study of the kinetics than formerly has now been made by Dr. H. W. Thompson and M. Meissner, who are of opinion that the process is of the same general type as the decomposition of acetaldehyde and other related substances, and involves the simultaneous occurrence of several quasi-unimolecular reactions.

Further experiments on rats showing that not only potassium iodide but also the iodides of sodium, lithium and magnesium, counteract to a great extent the chronic toxic effects (such as baldness) due to thallium acetate are reported by Prof. O. V. Hykeš and F. A. Diakov. It appears, however, that iodides are valueless as antidotes in acute thallium poisoning.

Research Items

A Second Neanderthal Man from Italy

THE discovery on July 16, 1935, of a Neanderthal skull, only the second to be found in Italy, in the quarry of Saccopastore, near Rome, is described by the Abbé Breuil and A. C. Blanc, the finders, in *L'Anthropologie*, **46**, Nos. 1–2. It was also in this quarry that the first Neanderthal skull was found in 1929. The quarry is part of a low river valley terrace, and has been abandoned for some years. Water has accumulated in the centre, and makes the sections difficult of access. The new skull was found in the north section. The stratification is complicated. The deposits evidently belong to two complexes, of which one is much older than the other. The two are separated by a period of erosion of marked intensity. The skull was found in the upper part of Stratum *F*, a deposit of fine sand belonging to the older complex, showing no stratification, and homogeneous. It was, however, also partly in the lower deposits of Stratum *E*, consisting of fine gravel mixed with sand. Although at present freed only in part from deposit, the skull can be seen to have the dentition of the right side complete, while the face on this side, almost intact, is high, with little prognathism and shows no trace of the canine fossa. The orbital cavity is large and rounded, as is also the nasal aperture. Two flint flakes were found *in situ*, one in immediate contact with the skull being subtriangular and pointed, measuring 25 mm. by 13 mm., while the other, found some metres to the east at the base of Stratum *E*, is a small irregular flake of calcedony, 40 mm. by 16 mm., and showing no retouch. A third, a flake of calcedony of unknown provenance, was found near the entrance of the quarry. The distal part of a broken tibia of *Bos* has a transverse fracture at its distal end caused by an intentional blow. The evidence of malacological fauna and molluscs, examined by Mr. A. S. Kennard, and the geological evidence, concur in ascribing the deposits in which the skull was found to a period of a cold dry steppe climate preceding the oncoming of Würm I.

Primitive Medicine in Malabar

MR. A. AIYAPPAN describes in *Man* of April the growth of a cult in the Cochin State of Southern India and its function among the populace as a means of curing a number of ailments. The shrine is situated near the Mullūrkara railway station, where a flat-topped hillock surmounted by a huge dolmen has on one side a vertical wall of granite, in which is a niche about 10 ft. high, with a spirited figure of Siva as *Dakshināmūrti* sculptured on it. The figure is in an unusual pose, turning away from two students at its feet. It has been attributed to the period between the sixth and eighth centuries. It was discovered accidentally by slaves, who were clearing vegetation. It was afterwards worshipped, first by low caste men and then by higher castes. Although it is in the possession of the Nayars, it is still used by all castes, including the unapproachable castes, who are allowed to make their offerings in person without the intervention of a priest. The reason for this variation from custom is thought to be that low castes began the cult. The people have discovered that *Dakshināmūrti* could be successfully invoked for driving away pestering spirits. To the unsophisticated Hindu, his deity and temple are more hope-giving than a hospital; and here the largest number of offerings are for curative purposes. Figures of an affected limb are offered in wood, stone or pottery, or when the disease is more general effigies of the whole body. Similar figures of live-stock are offered when they are ill. Cradles are offered for getting children, and figures of breasts by young women whose own breasts are under-developed. Figures of animal pests, such as rats, boars, etc., are used to secure protection from them. A wooden tortoise is said to have been a cure for stomach-ache. All offerings are placed before the deity for a short time and then heaped up by the side of the temple.

Viscera of Primates

STRAUSS (*Proc. Amer. Phil. Soc.*, **76**, No. 1; 1936) has dissected fully the viscera of three specimens of orang-utan, an old male with an anterior trunk height of 49·8 cm., a juvenile male and a new-born female. He has utilised the information thus obtained to preface a comparative account of the viscera of primates in general. It is found that the four anthropoids and man exhibit a group of characters in common that indicate their affinities and close genetic relationship. These include the high and partially transverse disposition of the heart, the reduction of lobation of the lungs, the restriction of the pleural sacs and their sternal dissociation, a true vermiform appendix, a sigmoid colon, the completion of an ascending mesocolon, the development of a secondary jejuno-ileal mesentery and the reduction (save in the gorilla) of hepatic lobulation. All of them offer a curious mixture of primitive and specialised characters, but there appears from the parts under review no reason for supposing man to be more closely related to the chimpanzee or even to the chimpanzee-gorilla stock than to the other primates.

Antarctic Foraminifera

MR. ARTHUR EARLAND has now published Part 3 of the Foraminifera ("Discovery" Reports, **10**, pp. 1–208. Cambridge: University Press, 1935. 37*s*. 6*d*. net). This embraces the Falkland Sector of the antarctic (excluding South Georgia), the first part having dealt with the bottom deposits of the Falkland Islands and adjacent seas, an area outside the extreme limit of the pack-ice, with a characteristic sub-antarctic fauna; the second part with the deposits of South Georgia, which lies within the antarctic regions although very nearly in the same latitude as the Falkland Islands. The present report deals with a large area farther south, extending over nearly 90° of west longitude, or practically a quarter of the south polar circumference. This is a very interesting contribution to our knowledge of the distribution of the group. It is a question whether the deep sea was populated by migration from cold polar waters, or whether the antarctic fauna had its origin in the deep sea. The author is inclined to the view that the antarctic fauna originated in migration principally from the deep water of the adjacent

oceans, and that the invasion is still in active progress. He believes that, with the exception of a few species which appear to have a circumpolar distribution and are not found in the deep sea of warmer latitudes, the present antarctic fauna represents the successful attempt at the colonisation of a fresh area. There are not many genera and species, and these are chiefly primitive forms, principally belonging to the Arenacea ; conditions of life not having favoured the hyaline and porcellanous forms to any great extent. Certain species of Pacific origin were found in these regions which had no previous antarctic history yet were known from Australia and New Zealand areas. This is specially the case with the genus *Lagena*, but there are also other forms which show an extension of the range of species in an eastern direction across the South Pacific. A few species appear to have a complete circumpolar distribution, and are not known outside the Antarctic.

Mallophaga or Bird-Lice from the Tinamous

M. A. CARRICKER, jun., has recently published an extensive paper on the above subject (*Proc. Acad. Nat. Sci. Philadelphia*, **88**, 45–218 ; 1936). Next to the struthious birds, the tinamous represent the oldest living family of birds. Their mallophagous parasites form the most extraordinary group of these lice of which we have any knowledge. The generic differences and extremes are very remarkable and can only be explained on the basis of the great antiquity of the host family. The great majority of the Mallophaga found on tinamous belong to a group of genera which constitute a new family—the Heptapsogastridæ, the chief character of which is the reduction of the abdominal segments to seven in number. This feature is brought about either by the complete loss of the first segment or by the fusion of the first and second segments. The author remarks that the tinamous possess the most diversified and bizarre collection of genera and species of Mallophaga, while the family, as a whole, will undoubtedly take first rank in the number of genera and species found on a single host species and individual.

An Amphidiploid Wheat

AN interesting new wheat hybrid is described by Dr. D. Kostoff (*C.R. Acad. Sci. U.S.S.R.*, 1, No. 1) between the tetraploid *Triticum Timopheevi* with 28 chromosomes and the diploid *T. monococcum* with 14. The F_1 hybrids were all sterile, but in a head which had been crossed with the pollen of an F_4 segregate from the triple hybrid, *T. turgidum* × *T. dicoccum* × *T. vulgare*, a single large grain was obtained. The plant raised from it had 42 chromosomes, and the evidence indicates that it was an amphidiploid produced by the parthenogenetic development of an egg of the *Timopheevi-monococcum* hybrid which had failed to undergo meiosis. This amphidiploid is intermediate between the two parent species, both of which, as well as the F_1 hybrid, were immune to rust and mildew. The amphidiploids are highly fertile, with spikes like the F_1 in glume and awn characters but, as is to be expected, the cells are larger. This new hexaploid wheat (called *T. Timococcum*) is regarded as a very promising form to cross with *T. vulgare*, and thus introduce immunity into the bread wheats. It is possible, however, that immunity may be determined, at least in part, by cell size, the diploid and tetraploid species being more immune because of their smaller cells.

Meteorology in Great Britain

THE latest volume of the "Weekly Weather Report" of the Meteorological Office, Air Ministry, which is now published only as an annual volume, is the fifty-seventh of the series. It covers the period March 4, 1934–March 2, 1935. The report is in the form that was first adopted for the volume giving data for 1929, according to which the information is partly expressed as weekly averages of the different meteorological elements regarded as of most importance for agriculture—temperature, accumulated temperature, rainfall and bright sunshine—and partly as deviations of these elements from their 'normals' or long period averages. There are fifty-seven well distributed stations to represent the British Isles, the stations being the same as those employed in the preceding volume. A table of normal weekly values for the twelve districts into which the British Isles are divided, based on the records of the standard 35-year period 1881–1915, is followed by another giving weekly departures for each district from the corresponding district normal, for the period under review, and these weekly deviations from normal are averaged for the four seasons and for the year. The character of the year in any district can be ascertained by a glance at this table. Then follow the weekly data for each individual station, one station filling one page, an arrangement which similarly presents the main features of the year, but for a particular place, in a very compact form. It can, for example, be seen with little trouble that in London (Kew Observatory) temperature in the whole year ranged from 27° to 84° and was nearly two degrees above the average ; that rainfall was distinctly below and sunshine distinctly above the average in spite of the very wet and dull winter, notably sunny periods being enjoyed in July and again during the last part of August and the early part of September. The column of figures representing the departure from normal of temperature shows that there was only one week which was so much as 5° below the normal—that beginning on Oct. 28, with an average of 42° ; that in the week beginning on Dec. 2 temperature averaged the remarkably high figure of 52·4°, an excess of nearly 11° above normal ; that, moreover, the cold week was preceded by twenty out of which only one was cold.

An Optical Model for Studying the Acoustics of Theatres

THE acoustic characteristics of a hall or theatre are almost completely determined by the reflection of the sound waves at the walls. The sound audible to the audience is caused by several factors. There are first the 'direct sound' waves ; secondly, the 'useful sound' which, in addition to the direct sound, includes every sound wave striking the ear within 1/15 of a second after the arrival of the direct sound; thirdly, 'reverberation' which includes the useful sound and all the contributed sound waves which reach the ear after 1/15 of a second ; and finally 'echoes'. An echo is a reflected sound wave which owing to the peculiar shape of part of the reflecting walls predominates over the reverberation by means of its high intensity. The reverberation period is defined as the time taken by the intensity of the sound to decay to the millionth part of its initial intensity. In the case of musical productions and the spoken word, definite reverberation periods give optimum results. In the ideal theatre, the whole sound radiated from the source would reach the audience

as useful sound. Unless the speaker is surrounded by a sound reflector, this acoustic ideal cannot be even approximately realised. In *Philips Technical Review* of February, there is a description of an optical model which was used to perfect the acoustics of the Philips theatre at Eindhoven. The model of the hall is made of sheet aluminium, and a small movable lamp is used as a 'sound-source'. About 50 per cent of the light is reflected from the walls, so that after three reflections the initial intensity of the light is reduced to about ten per cent. The luminous intensity at each point on the model is therefore determined by the interaction of only a few reflected rays and so the resultant luminous intensity is an approximate measure of the useful sound intensity. The model showed at once that the greatest part of the audible sound came from the roof. This proves that in an open air theatre the spoken sound is much less audible. Further experiments with another model enabled completely satisfactory results to be obtained.

High-Frequency Electric Melting Furnace Equipment

IN the *G.E.C. Journal* of May a description is given of a high-frequency electric melting furnace equipment recently installed in the Novo Steel Works at Sheffield. When the works were first founded in 1870, the whole of the steel produced was made from wrought iron by the cementation process followed by forging. Since then, the equipment has been continuously altered as the demands made for complete heat treatment, especially the treatment required for the high-class steels used for aircraft and motor-cars, have increased. The conditions required for their manufacture in the casting shop are now comparable for those associated with laboratory methods so far as precision, control and cleanliness are concerned. Analysis shows that the steel made in the high-frequency furnace on a commercial basis is of exceptional purity and uniformity. Stainless and other steels which contain high percentages of chromium, tungsten, molybdenum and other alloying additions are made without appreciable loss of these constituents and without carbon increment or the picking up of sulphur or other deleterious elements. It has been proved that if more than one ingot is poured from one melt, each ingot and every part of each ingot gives practically the same analysis. This is due to the well-known stirring effect caused by convection currents within the molten charge, a phenomenon inherent and peculiar to the high-frequency furnace. So far as the workmen are concerned, the working conditions are greatly improved, as it is comparatively cool and comfortable in the neighbourhood of the furnace. The capacity of the larger of the two furnaces described is half a ton.

Carbohydrate Metabolism

A USEFUL review, by Prof. O. Meyerhof, of recent work on carbohydrate metabolism is published (in German) as a supplement to the March 1936 issue of *Current Science* (4, 669–682). The author confines himself chiefly to a discussion of experiments carried out in collaboration with K. Lohmann and W. Kiessling, in which the cause of alcoholic fermentation and the formation of lactic acid by enzymatic breakdown of carbohydrates were studied. As a result of these researches, the author formulates schemes for the series of changes occurring in both processes, which represent a further advance in our knowledge of carbohydrate metabolism (see NATURE, 132, 337 and 373; 1933). The scheme for lactic acid formation is more detailed than that of Embden, from which also it differs at several points: thus in the initial reaction adenylpyrophosphate reacts with hexose to form hexosediphosphate and adenylic acid: the diphosphate is then converted into α-glycerophosphate and phosphoglyceric acid via dioxyacetone phosphate: Embden suggested that the intermediate stage was glyceraldehydephosphoric acid with dioxyacetonephosphoric acid. The phosphoglyceric acid is then converted to phosphopyruvic acid, which reacts with hexose to form hexosediphosphate and pyruvic acid. The latter reacts with more hexose and phosphate to form triosephosphate, which with pyruvic acid is converted to phosphoglyceric acid again and lactic acid: in Embden's scheme the process is simpler, the phosphoglyceric acid being converted to pyruvic acid and phosphoric acid, the former reacting then with α-glycerophosphoric acid to form triosephosphate and lactic acid. The paper is illustrated with curves describing the experiments from which Meyerhof has been led to suggest his modified schemes for both fermentation and formation of lactic acid.

Constitution of Acacipetalin, a New Type of Glucoside

DR. CLAUDE RIMINGTON has recently described the isolation and constitution of a new type of glucoside, which occurs in several South African species of *Acacia* (*S. African J. Sci.*, 32, 154; 1935). *Acacipetalin* is distinguished from all known cyanogenetic glucosides, including the corresponding product *sambunigrin*, which is found in the Australian acacia, in yielding neither aldehyde nor ketone when hydrolysed by acids. It is true that a small yield of acetone resulted from enzyme hydrolysis, but comparison of the molecular formula $C_{11}H_{19}O_6N$ of acacipetalin with that of linamarin $C_{10}H_{17}O_6N$, the β-glucoside of acetonecyanhydrin, led to the interesting discovery that the acetone was a secondary product, formed by disintegration of the unstable 'aglucone' or primary product of hydrolysis. The isolation of acacipetalin was rendered somewhat difficult on account of its association with *pinit*, the monomethyl ether of inositol, which is somewhat similar in properties. Eventually the glucoside was obtained as colourless crystals, which melt at 176° C. and are bitter to taste. The aqueous solution is lævorotatory, the value of $[\alpha]_D^{26°}$ being $-36{\cdot}6°$. Its molecular weight was determined cryoscopically, and ample chemical evidence was found of the presence in the molecule of prussic acid and one glucose unit. The results of acid hydrolysis were puzzling, since isobutyric acid was formed, but the key to the molecular structure was provided by subjecting the glucoside to the action of boiling baryta solution before attempting acid hydrolysis. The glucosidic linkage is practically untouched by the baryta, which merely hydrolyses the cyanogen group. This has the effect of stabilising the 'aglucone', which was identified as isobutyrylformic acid (α-oxo-β-methylpropane-α-carboxylic acid) $(CH_3)_2CH.CO.COOH$. This led to the establishment of the constitution of acacipetalin as the glucose ether of dimethylketenecyanhydrin $(CH_3)_2C : C(CN).O.C_6H_{11}O_5$, and it is tentatively suggested that the natural synthesis may be due to the condensation of glucose, acetone and formaldehydecyanhydrin.

The Present State of the Theory of Natural Selection

ON May 14, the Royal Society held a discussion on "The Present State of the Theory of Natural Selection". Prof. D. M. S. Watson, opening the discussion, emphasised the lack of evidence that structural features are adaptive. In the brachiopod *Rhynchonella*, specimens with the inhalent and exhalent apertures completely abnormal occur abundantly in a random collection of large numbers, of different sizes, from one locality: the abnormality has not been selected out. Much more experimental proof of a selective death-rate is needed. While a change may take place independently on parallel lines, the rate may differ; there is a compensatory principle as in the evolution of the horse, in which an advanced rate of change in the teeth is associated with a backwardness in the case of the feet. The same adaptive structure may arise independently in nearly allied animals, or the same ends may be served by different adaptations in other groups. Perissodactyls show a dental peculiarity, increasing the grinding surfaces, which artiodactyls never do; what it is that prevents them from doing so, is a clue to evolution. Such types of evolution, common to great groups, have nothing to do with the evolution of specific characters. Do ordinary species differ from each other by adaptive characters? Quantitative results are of the utmost importance, yet they are not forthcoming.

Prof. N. Timoféeff-Ressovsky produced important figures dealing with relative viability in races of *Drosophila*. A state of over-crowding in a culture of the flies under optimum conditions can be produced by the introduction of others, leading to the death of a certain number. The percentage of viability of various cultures thus over-crowded shows that certain races will survive better than others at raised or lower temperatures. Although races from different areas may show no morphological differences, their viabilities at different temperatures agree with the climatic conditions of the areas they occupy. The populations of eastern Europe in a typical continental climate have higher viability at temperatures beyond normal in either direction than the north European race, which endures increased cold better than the Mediterranean race; this, on the other hand, endures increased heat alone better than the former. There is evidence that there do exist in the wild population sufficient allelomorphs to provide material for selection for climate, and that each of the mutants has its own specific relative viability dependent upon combination with other genes; small mutations affecting viability occur at least twice as frequently as lethals.

The differential elimination of genotypes of low viability was discussed by Prof. R. A. Fisher in the case of four species of grass locusts. There was unmistakable evidence of this, by deaths between the time of formation of the zygote and the time of capture, or between the time of capture and the time of formation of the next generation. In one case, not even complete sterility would explain the disparities observed; there must have been differential elimination of one genotype of low viability.

Prof. E. J. Salisbury urged that plants have much greater tolerance to supposedly lethal conditions than is thought to be the case; elimination is largely among juveniles. Survival is determined by reaction to competition for space; wild communities of an open character contain many microspecies. Allied microspecies grown in dense cultures show great mortality; a denser culture of a single than of mixed microspecies can be grown. Despite Darwin's axiom that competition is greatest between individuals of the same species, if they have no different competitive equipment, enormous numbers can live together without mortality.

The view that natural selection reduces polymorphism and favours distinct species in different environments was expressed by Dr. W. B. Turrill, who cited many cases of close adaptation to environment in plant species growing in contiguous areas, differing by well-marked characters yet each not spreading from its own area. The colonisation of a new area may be aided by a difference in habit, and Dr. T. J. Jenkin ascribed the difference between the annual rye-grass occurring in South Europe and the northern perennial species to an original divergence of habit which favoured different forms in different climatic environment. Such differences were not shown in morphology; the grasses are all diploids, and can be intercrossed without any noticeable change except a disturbance of meiosis.

Close adaptations were stated by Capt. Cyril Diver to be limitations; many species do not show them, and they may even be disadvantageous. Wide variability goes with adaptability; more common species are more variable than the less common, so that a successful species may be presumed to preserve wide adaptability. If close adaptations are a measure of the working of natural selection, wide adaptability, being incompatible with them, can scarcely be attributed to natural selection. The important thing for a species is to be tolerant and preserve a wide adaptability, and not close adaptations. This is best effected if there is no selective pressure to limit these adaptations; a condition of selective pressure causing close adaptation suggests that a species is losing rather than gaining ground.

There is difficulty in believing that adaptation is due to natural selection in cases where a new form is found living under the same conditions as its parent form. This point was also emphasised by Prof. R. Ruggles Gates; there is little evidence that natural selection is aiding the spread of new forms. Thus an apetalous form of *Saxifraga virginiensis*, having started in Manhattan, has become abundant in Massachusetts; a teratological form of *Drosera* spreading vegetatively has occupied an area of half an acre to the exclusion of the type form. The size of a population is of extreme importance; much depends upon whether all individuals can meet to interbreed, which is unlikely in widely scattered species. There is an effective range of interbreeding which will be less than the total range. Even migratory birds return to breed at the same spot, but plants have their effectiveness increased by necessary visits of pollinating insects or of wind. Therefore an element of chance may affect spread.

Dr. W. B. Turrill pointed out in his contribution that large changes of environment, such as is produced by man's deforestation, afford opportunities

for establishment of a new population, and that migration might be of less importance than changes *in situ*.

Theories of evolution were divided by Prof. R. A. Fisher into two kinds: those that explain adaptations, and those that fail to account for them. The development of the living organism must account for adaptations, otherwise (1) species must arise by an inner urge causing a progressive predetermined course undeterred by differences of birth or death, (2) the environment must govern the course of change. The "mutation theory, once popular among geneticists", omits the consideration of adaptations, and fails to explain the functions of organisms or their parts.

Dr. R. N. Salaman, in a few words at the end of the discussion, showed that a mutation might arise which only in certain circumstances might be of direct value to a species. A *Solanum* from Mexico, a country free from wart disease, has in Great Britain developed a recessive, bred true, which is immune to wart: a character that is useless in its native country but of the utmost value for England.

The value of protective adaptations in mimicry among arthropods was stressed by Prof. G. D. Hale Carpenter. Mimetic effects are produced in a variety of ways all serving the same end; a characteristic product of natural selection. Polymorphism in the case of mimicry is favoured by natural selection, contrary to the views of Dr. Turrill. A species gains by resemblance to different models or many kinds of inanimate objects, as this increases the work the enemy has to do in finding food. Habit plays an important part; conspicuous species furnished with unpleasant qualities have habits displaying them; mimics have habits enhancing the likeness, but often abandoned in real danger. The fact that mimicry deceives the artist but not the anatomist can only be explained by natural selection. The correspondence between models and mimicry in precise distribution is of utmost importance.

The question of numbers was discussed by Prof. J. B. S. Haldane. We are not in a position to detect evolutionary changes in a population at our disposal. Palæontologists agree that at least 20,000 generations are required to produce a recognisable change. If a gene is increased by 0·01 per cent, its frequency will increase in a random population from 0·01 to 99 per cent in 23,400 generations; but it would need a population of four millions to reveal it. This point had been also considered by Prof. Ruggles Gates, who said that in quite small populations the conditions would scarcely differ from chance survivals.

Prof. Haldane also said that new genes must be such as to decrease fitness, for if not they would already have spread through a population. The primary role of natural selection is to stabilise a species. Evolutionary changes are only to be expected as a result of drastic changes in environment; there is rarely direct evidence of selection. But such evidence exists in man, in the case of resistance to a disease: the progressive diminution of tuberculosis is due to natural selection developing immunity.

Parallel mutation was discussed by Prof. Ruggles Gates: it is so abundant, causing parallel evolution, that we must look on phylogeny not as like the usual Darwinian tree, but as the root system of a fig-tree which sends down parallel roots, descending and interlacing.

The facts of mimicry in insects, however, according to Prof. Hale Carpenter, cannot be explained by parallel mutation. The results in mimics and models are not the same, and similar effects are produced in different ways. One of a series of forms of a polymorphic mimetic species, of which the majority mimic species of one subfamily, may mimic a species of quite a different subfamily, and yet this form is linked with the others by intermediates.

The Mysterious Number 137

IT is a remarkable fact, first made prominent by Sommerfeld's discussion of the fine structure of the hydrogen spectrum, that from three physical constants, h (Planck's constant), c (the velocity of light *in vacuo*) and e (the charge on an electron), a dimensionless pure number can be formed, which usually occurs in the form $hc/2\pi e^2$, with the numerical value 137, or more accurately 137·2.

Dr. Max Born, in a lecture delivered to the South Indian Science Association at Bangalore on November 9, 1935 (*Proc. Indian Acad. Sci.*, **2**, 533; 1935), declared that the explanation of this number must be the central problem of natural philosophy. Its existence can be ascribed to the fact that there are two different 'natural' units of length, a larger one $\lambda_0 = h/mc$ (the so-called Compton wave-length) taken from quantum theory, and a smaller one $a_0 = e^2/mc^2$ (the so-called radius of the electron). Their ratio is 2π times the mysterious number. After pointing out the great importance of this number in atomic physics, Dr. Born criticised the existing explanations of it.

Sir Arthur Eddington considers that it is associated with the number of degrees of freedom of a pair of electrons, and obtains the value 137. Dr. Born rejects this view, and seeks for an alternative explanation based on the new Born-Infeld-Pryce unitary field theory, which considers matter and field as one and the same. It involves a very large constant called 'the absolute field', which is the magnitude of the field in the centre of the electron. It is suggested that the number 137 is related to the neutralisation frequency of oscillation of a pair of electrons, one positive and the other negative (produced by light quanta passing the field of a nucleus), which approach and finally neutralise each other, emitting light quanta. Apparently the details of the calculation have not been worked out on Born's own theory, but by working on a somewhat similar theory Euler and Kockel (two pupils of Heisenberg) obtain the value 82·4. This differs considerably from the value 137·2, but Dr. Born considers the discrepancy not discouraging in view of the arbitrary assumptions made in the theory.

Dr. Born also uses the new field theory to explain the ratio of the proton and the electron, and obtains the number 2340. The experimental value is 1846·6, and the theory of Sir Arthur Eddington gives the value 1847·6 (*Proc. Roy. Soc.*, A, **134**, 524; 1931).

Prevention of Scaling of Mild Steel

IN the heat treatment of steel during manufacture, scale is formed on the surface by oxidation. This involves a loss of metal which in the aggregate is enormous. Moreover, the actual monetary loss is much increased from the damage to the surface, necessitating machining, and from the production of wasters outside specified dimensions.

The factors affecting scaling are temperature, period of heating, nature of the steel and furnace atmosphere; but of these, all but the furnace atmosphere are determined by considerations quite apart from those of minimum scale formation. The normal method of minimising scaling is to heat in a reducing atmosphere, which in the case of a coal-fired furnace means the emission of smoke and, at the same time, a fuel loss represented by the potential heat in the incompletely burned products of combustion. In the past, so well established was the tradition that a smoky atmosphere was essential to reheating furnaces, that steel-makers were exempt from many of the provisions of the Smoke Abatement Acts.

The influence of the composition of the atmosphere has received a systematic survey at the University of Leeds, and is described in a report by Dr. H. C. Millett and Prof. J. W. Cobb presented to the Institution of Gas Engineers in November last. Special attention was given to the influence of sulphur dioxide, oxygen or reducing gases in the furnace atmosphere. The 'neutral' furnace atmosphere, representing the products of the complete combustion of a fuel with no excess of air, was itself oxidising, water vapour being a more powerful oxidant than carbon dioxide. The addition of small and increasing percentages of oxygen to the 'neutral' atmosphere was accompanied by a rapid increase in the scaling, whereas similar small quantities of reducing gases were much less effective in restraining scaling.

Observations made upon the influence of the sulphur content of the fuel disclosed some interesting features. It was found, for example, that at 1,000° C., 0·10 per cent sulphur dioxide in the 'neutral' atmosphere, the quantity forthcoming from an average coal or fuel oil, gave the same increase in scaling as 1·0 per cent oxygen in the furnace atmosphere. These results bear on the question of the degree of purification necessary when coke oven gas is to be used for steel manufacture.

The authors conclude that the best results as regards freedom from scaling will only be obtained from furnaces so designed, constructed and controlled in use that an atmosphere containing no free oxygen and a minimum of sulphur dioxide and steam can be consistently maintained, but that complete elimination of scaling, as is sometimes required, can only be brought about efficiently by indirect heating, in which the bulk of the products of combustion does not come into contact with the metal.

Petroleum Research

THE petroleum industry in America has been initiated and developed practically within the last thirty years; yet it is to-day there regarded as one of the most important industries. Not only is about eighty per cent of the rated horse-power of that country generated by oil and its products, but in addition the petroleum industry is one of the largest purchasers of steel, iron and motor-vehicles, etc. At the same time it is the second largest customer of shipyards, which supply the necessary tank ships for transport.

The Gulf Research and Development Corporation, Harmaville, Pa., has recently circulated a brochure which delineates the part played by industrial research in the solution of scientific, economic and social problems arising in the past in connexion with exploitation of petroleum, and indicates lines on which immediate problems are to be tackled. This is of particular interest in that it becomes evident during perusal that there is no phase of petroleum discovery, exploitation, refining or marketing which is not governed by laboratory or field data obtained as the result of intensive research. In exploration work, the geophysicist has superseded the less reliable, casual prospector, and by magnetic, gravitational, seismic or other methods is able to obtain a more or less accurate map of rocks lying many thousands of feet below the surface. In production, small samples of rock can be removed from the boring and analyses made to determine porosity, permeability and other relevant characteristics. Further, by correlation of results an estimate can be made of total thickness and areal extent of oil-bearing strata.

The annual losses of the petroleum industry from mechanical failure of equipment and corrosion amount to some millions of dollars. This alarming fact shows how vital it is that research should be prosecuted to find materials most suited to withstand the particular strain imposed upon them by petroleum engineering. Already it has been proved that steel of low carbon content and containing up to 4·5 per cent of nickel is better than the ordinary type for this work; this is only one of many important discoveries which help to reduce losses to the industry as a whole.

The aim of research workers is to reach a point where specifications can be issued to the industry for all classes of materials, which will guarantee maximum return in service for each dollar invested in equipment.

Enormous scope is offered to research workers in selection of the best product for a particular purpose. Already there are more than four hundred uses to which petroleum products are put, for each of which it is necessary to provide many different materials because of variations in application. When it is considered that technical progress is being made every day in each of the industries served by petroleum, then it must be admitted that the field of petroleum products research itself is correspondingly boundless.

Educational Topics and Events

CAMBRIDGE.—B. C. Browne, of Pembroke College, has been appointed University demonstrator in the Department of Geodesy and Geophysics.

M. H. A. Newman, of St. John's College, and W. V. D. Hodge, of Pembroke College, Lowndean professor elect, have been appointed delegates from the University to the International Congress of Mathematicians to be held in Oslo on July 13–18.

GLASGOW.—Sir Hector Hetherington has been appointed principal of the University in succession to Sir Robert Rait who will retire on September 30. Sir Hector was principal and professor of philosophy in University College, Exeter, from 1920 until 1924, and has been vice-chancellor of the University of Liverpool since 1927.

The Senatus Academicus of the University has resolved to confer the honorary degree of LL.D. on the following, among others, at the graduation ceremony to be held in June: Prof. Ludwig Becker, emeritus professor of astronomy in the University; Prof. T. H. Bryce, emeritus professor of anatomy in the University; Dr. Ernst Cassirer, formerly rector of the University of Hamburg; Sir George Arthur Mitchell, president of the Mining Association of Great Britain; and Sir Leonard Rogers, president of the Royal Society of Tropical Medicine and Hygiene.

Sir Robert Muir is retiring from the chair of pathology at the end of the current session. Sir Robert has occupied this chair since 1899, and under his direction the Department has grown into one of the leading centres of pathological research, with modern well-equipped laboratories.

Profs. E. B. Bailey and Edward Hindle have been appointed official representatives of the University at the Harvard tercentenary celebrations.

Sir Daniel Stevenson, Chancellor of the University, has provided funds which amount in immediate capital value to £4,000 for an extension of the buildings of the Department of Botany. This very generous gift by one who has founded two chairs and a lectureship and has helped the University in other ways as well, will provide a laboratory for classes in advanced physiology and mycology and several private research rooms for members of the staff or research students. The present building, which was opened in 1901, thanks to the foresight of Prof. F. O. Bower, is well equipped with lecture-rooms and laboratories for large elementary classes, and with the additional facilities provided by the Chancellor's gift will be well fitted for advanced teaching and research in the more important branches of botany.

LONDON.—At the meeting of Convocation held on May 12, the following resolution moved by Mr. J. Stewart Cook was adopted by a substantial majority: "That Convocation is strongly of the opinion that adequate accommodation on the Bloomsbury Site should be reserved 'to promote research and the advancement of science and learning', to train graduates in the methods and spirit of scientific and technological research, to co-ordinate research work carried out under University Professors and Teachers in the constituent colleges, and, in particular, to provide facilities for external graduates desirous of undertaking post-graduate research work." A resolution moved by Dr. Brinley Thomas in favour of the application of the principles of the Ballot Act of 1872 to university parliamentary elections was also adopted. A motion relating to the Bloomsbury site, of which Mr. T. Ll. Humberstone had given notice, was deferred to the next meeting to be held in October.

THE Annual Conference of the Association of Teachers in Technical Institutions will be held at Plymouth on May 30–June 2, under the presidency of Mr. W. T. Maccall, of the Technical College, Sunderland. The following resolutions will be considered: part-time and full-time day courses; overtime and shift system; school leaving age; extension of technical education; recruitment in industry. Further information can be obtained from the Secretary, Mr. J. Wickham Murray, 29 Gordon Square, London, W.C.1.

IT is hoped to make an appointment to a Busk studentship in aeronautics during July, 1936. The studentship is of the value of about £150 and is tenable only by a British subject. Research may be carried out either at home or abroad. Further information can be obtained from Prof. B. Melvill Jones, Engineering Laboratory, Cambridge.

Science News a Century Ago

Faraday and Schœnbein

ON May 26, 1836, Faraday entered in his "Diary" that he had "been making a few experiments this morning in relation to Professor Schœnbein's [of Basle] letter to me on the relation of Iron to Nitric acid and other metals". The experiments which were begun on that day were continued at intervals, as the entries show, until June 17. The letter from C. F. Schœnbein referred to, a lengthy one describing observations on the passivity of iron under certain conditions in nitric acid, was afterwards communicated by Faraday to the *Philosophical Magazine*, together with a dissertation of his own upon the subject, and published (*Phil. Mag.*, 9, 53; 1836) under the title "On a Peculiar Voltaic Condition of Iron".

Schœnbein's letter opens with the words: "As our continental and particularly German periodicals are rather slow in publishing scientific papers, and as I am anxious to make you as soon as possible acquainted with some new electro-chemical phenomena lately observed by me, I take the liberty to state them to you by writing. Being tempted to do so only by scientific motives, I entertain the flattering hope, that the contents of my letter will be received by you with kindness". Apart from its scientific contents, this letter is of interest as the first that Schœnbein wrote to Faraday. It was the beginning of a correspondence which extended over twenty-six years. Encouraged by Faraday's interest in his experiments, Schœnbein wrote again. From this beginning there grew up first an acquaintance and afterwards, when they had met, a warm friendship between the two men which lasted to the end of Faraday's life. The growth and continuance of their regard for each other may be traced in the valuable edition of "The Letters of Faraday and Schœnbein" prepared by Kahlbaum and Darbishire and published in 1899.

The Whitby and Pickering Railway

ONE of the earliest sections of the present system of the London and North Eastern Railway to be opened for traffic was that from Whitby to Pickering

in the North Riding of Yorkshire. The line included nine bridges, one 312 ft. in length, and a tunnel 130 yards long at one end of the Vale of Goathland. It was opened on May 26, 1836, as a horse-worked railway. "The trains in both directions had heavy gradients to overcome, and, since they were contiguous and too steep for horses to surmount, a most ingenious method was employed. As the traffic for each direction was irregular and unequal, a tank was provided, mounted on railway wheels, at the top of the incline, which could be filled with water, to give a greater load than that to be hoisted. When the wagons had been pulled up the ascent the water was allowed to run away at the foot of the descending incline." (Sherrington.)

Standard Scale of the Royal Astronomical Society

In the *Athenæum* of May 28, 1836, is a long abstract of the Report on the Standard Scale of the Royal Astronomical Society, the consideration of which had occupied the Society on three evenings. The Report was drawn up by Baily. It contained first a history of the British Standards down to the destruction of the Parliamentary Standard during the fire at the Houses of Parliament in October 1834. In consequence of the destruction of the Parliamentary standard, said Baily, and the uncertainty whether the Government will think proper again to interfere and decide upon the subject, it becomes necessary that the scientific world should agree upon some definite standard to be appealed to on all occasions where great accuracy and precision are required. The important trigonometrical operations in England, Wales, Ireland and India will lose much of their value if they are not reduced to some known and permanent standard of measure, comparable with the standards of other countries where similar operations have been performed. A great variety of subjects might be adduced where extreme precision and accuracy are requisite, and it is hoped, he said, that the new standard scale of the Society will tend to remove some of the inconveniences and evils to which reference had been made.

Natural History Museum at Leyden

In a note in its column of "Miscellanea" in its issue of May 28, 1836, on the museums of Holland, the *Athenæum* said: "So much attention has been directed to public museums that [they were glad] to publish an account by a correspondent on the Museums of Holland. At the Hague there was a Gallery of Paintings, a Royal Museum of Curiosities, containing an ethnological collection, a Museum of National Antiquities, and the Royal Cabinet of Medals, Coins and Gems housed in the Royal Library. At Amsterdam there was a National Museum of Paintings, Statues, etc., and at Leyden a noble Museum of Natural History, enriched with the numerous collections from the Dutch Colonies in the East and West Indies, and the magnificent assemblage of natural objects which formerly belonged to that eminent naturalist Temminck, who is the director of the establishment. Several travelling naturalists were employed in searching for the varied treasures of nature in different parts of the world, and in transporting them to the grand repository at Leyden, which though supported by so small a state as Holland, would bear comparison with any museum in Europe."

Societies and Academies

DUBLIN

Royal Dublin Society, March 24. G. CRUESS CALLAGHAN and M. J. GORMAN: Loss of colour in violet bacteria. Loss of colour which occurs in cultures of these organisms when they have been in cultivation for some time does not appear to be affected, as is known to be the case in other pigment-producers, by the composition of the medium. The temperature of incubation and the reaction of the medium were the only conditions of those investigated found to influence the colour of the cultures—most pigment being produced at 25°–28° C. and *p*H 7–8. ROBERT MCKAY: Method of infection of oat grain with *Ustilago Avenæ*, and the influence of external factors on the incidence of the disease. Flower inoculated oats were compared with grain contaminated previous to sowing in two successive years. Under the experimental conditions described, and using spores of high germination, shelled grain contaminated before sowing gave the highest percentage of infection, followed by that with hulls intact and then flower inoculated oats. In the case of flower inoculated oats, de-hulling reduced infection by 35–50 per cent, washing reduced infection by 32–56 per cent, and de-hulling and washing reduced infection by 62–96 per cent when such grain was sown. The conclusion arrived at was, that most of the infection was derived from viable ungerminated spores and not from resting mycelium.

Royal Irish Academy, April 27. J. G. SEMPLE: Contact conditions for surfaces. The theory of multiple contact of surfaces, at a point (node or binode) or along a curve, is discussed, purely synthetic methods being employed instead of the strictly algebraical machinery of previous investigators, notably Miss Hudson, in this field. After considering the analysis of binodes into chains of infinitesimal curves, total infinitesimal bases at binodes, the abstract s fold curve strip, and the behaviour of the curve of intersection of two surfaces at a binode of (s_1, s_2) contact, the author justifies the introduction of virtual genera for all the contact conditions concerned, and evaluates their postulation and equivalence, thus verifying independently, and in some cases extending, Miss Hudson's results.

PARIS

Academy of Sciences, April 15 (*C.R.*, 202, 1317–1532). The president announced the death of Maurice Hamy, past president of the Academy. EMILE JOUGUET: Comments on the theory of waves of shock produced in a gaseous atmosphere by a solid explosive. RENÉ HARMEGNIES: The movement of a plane figure which remains homographic to itself. A. KOLMOGOROFF: The properties of Betti groups of locally bicompact spaces. PAUL ALEXANDROFF and LÉON PONTRJAGIN: Varieties of n dimensions generalised. LÉON DUBAR: The nature of the superficial conductivity of cuprous oxide. After removal of gas by prolonged heating in a vacuum, the surface conductivity of cuprous oxide becomes negligible. This is also the case with the fresh surface obtained by breaking a specimen in a vacuum. JEAN JACQUES TRILLAT and SHIGUEO OKETANI: Electronic analysis: the influence of a prolonged passage of a bundle of electrons through thin films. Local bombardment with the electron stream causes changes in the surface

of a thin gold film : the diagram becomes faint and finally disappears. A local rise of temperature caused by the electrons is suggested as the cause. EMILE PIERRET and CHARLES BIGUENET : The influence of a uniform magnetic field on the ultra-short waves obtained with a triode lamp. JACQUES BÉNARD and GEORGES CHAUDRON : Contribution to the study of the decomposition of ferrous oxide. MARCEL TUOT : Some secondary acyclic alcohols from C_7 to C_{10}. EMILE FLEURENT : Contribution to the physical and chemical study of bread-making. ALBERT PORTEVIN and ROBERT LEMOINE : The influence of various factors on the formation of graphite during the solidification of iron castings. LOUIS ROYER : The influence of the symmetry of the medium on the symmetry of corrosion figures in crystals. New examples. MARIUS BACCINO : Joint action of temperature and plant poisons on the development of young mammals. ALBERT GORIS and HENRI CANAL : The composition of the essence of *Primula auricula*.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, 32, No. 2 ; 1936). F. SWARTS : (1) On fluorocyclohexane. Method of preparation and various chemical properties of this compound are described. (2) On catalytic hydrogenation of organic fluorine compounds. The fluorine in fluorbenzene is readily replaceable by hydrogen in catalytic hydrogenation, but that in fluorocyclohexane is not. H. BUTTGENBACH : Measurement of the angle of the optic axes and determination of the optical sign by means of refractometry. Description of a method applicable to the case of a section parallel to the plane of the optic axes. V. WILLEM : The respiratory triphasism of the lizards. Differences in the respiratory movements of reptiles and mammals are examined. F. BUREAU : Integration of linear equations with partial derivatives. M. KOURENSKY : Generalisation of the Charpit-Lagrange method for the integration of first order equations with partial derivatives. F. BACKES : A characteristic property of W congruences. L. LONG : A plane net (4). YVONNE DUPONT : Electromagnetic force and couple in a gravitational field. B. ROSEN and F. MONFORT : A new band system of Se_2 in the red. A new system having the same upper level as the principal system $^1\Sigma - {}^1\Sigma$. P. GILARD and L. DUBRUL : Introduction to the knowledge of the dimensions of the aggregates in silica glasses at high temperatures. Determination of the molecular weight of the polymerised aggregates in glasses from the variation of their viscosity with temperature.

ROME

Royal National Academy of the Lincei (*Atti*, 22, 483–548 ; 1935). E. BOMPIANI : Some projective invariants of curvilinear elements. R. EINAUDI : Cauchy's problem by means of differential equations with singular coefficients. L. SONA : Translo-circulatory current which invests a bilateral lamina. Aerodynamic applications (5). F. ODONE : (1) General equations of turbulence. (2) Absolute systems of units of measurement. L. LABOCCETTA : Determination of the earth's dimensions by means of the mechanical method of Galileo through the measurement of the distance of inaccessible points. G. SUPINO : The plane elastic problem and its interpretation in space (1). L. GIALANELLA : Eccentricity perturbations in the problem of two bodies with slowly increasing masses. G. RAMACCIONI : Skeleton of *Elephas planifrons* found in the Pliocene of the Val d'Era. E. SILVESTRONI : Effects of mono- and bilateral subrenalectomy on the nuclear sizes of some endocrine organs. G. AUSTONI : Determination of ciliary movement and of its polarity studied by means of the ultra-violet irradiation of neurules of *Rana esculenta*.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 22, 151–193, March 15). CLARK WISSLER : The excess of females among the Cree Indians. In aboriginal times, the excess was due to the hazards of hunting taking toll of young males ; on the reservations, these hazards largely disappear and the proportion of males soon increased. A. M. PARTANSKY and H. K. BENSON : Anærobic fermentation of sulphite waste liquor by bacteria of freshwater muds. Methane-type fermentation, resulting in the gasification of all organic constituents with the exception of lignin, took place with every organism used (temperature 36° C., incubation time 340 days). The heating value of the methane and carbon dioxide produced was 18,730 horse-power hours per ton of pulp manufactured. The lignin can be oxidised slowly biochemically at high dilution. Its pollution effect is thus small, but it slows down gasification of the other constituents (sugars) of the waste liquors and should therefore be removed. LINUS PAULING and CHARLES D. CORYELL : The magnetic properties and structure of the hæmochromogens and related substances. The hæmochromogens (compounds of ferrous protoporphyrin and other substances, usually containing nitrogen) are characterised by two sharp absorption bands, at about 5600 A. and 5200 A. respectively. In a hæmoglobin derivative, this feature is correlated with a structure in which the four porphyrin nitrogen atoms form covalent bonds with a central atom (iron). The same correlation of spectrum and structure can be made for hæmochromogen-like substances not containing iron. DONALD F. JONES : Segregation of colour and growth-regulating genes in somatic tissue of maize. The evidence of colour- and growth-mosaics (areas of different colour and 'pits' or tumour-like growths respectively) on maize seeds suggests segregation of genes for these characters. CHARLES N. MOORE : Convergence factors for double series summable by Nörlund means. H. BATEMAN : Functional differential equations and inequalities. EDWARD KASNER : A complete characterisation of the derivative of a polygenic function. CHESTER STOCK : *Hesperomeryx*, a new artiodactyl from the Sespe Eocene, California. Teeth, fragmentary jaws and other skeletal remains of no less than a hundred individuals have been found. F. ZWICKY : Absorption of cosmic rays in the Milky Way. If cosmic rays are extra-galactic in origin, the intensity in directions from the centre of the Milky Way should be less than in directions from its poles, due to increased absorption. The difference should be detectable. Its observation would enable a determination to be made of the amount of matter in the Milky Way in the form of particles less than 10–100 cm. in dimensions. C. A. BERGER : Observations on the relation between salivary gland chromosomes and multiple chromosome complexes. The two types seem to have no connexion with each other ; no evidence was found for the view that salivary gland chromosomes are compound in nature. J. VAN OVERBEEK : Different action of auxin-*a* and of hetero-auxin (preliminary note). Whereas the growth curvature of coleoptiles

stimulated by auxin-*a* is decreased by exposure to light, those treated with hetero-auxin are not affected. Sections of coleoptiles inactivate auxin-*a* but not hetero-auxin. C. A. G. WIERSMA and A. VAN HARREVELD: The double motor innervation of a crayfish muscle. Two motor axons only were found for the adductor muscle; the larger evokes a twitch and the smaller a slow contraction. A. G. JACQUES: The kinetics of penetration (13). Effect of *p*H on the entrance of potassium into *Nitella* at low concentrations. The lower the *p*H in the range used (6–8), the greater the tendency for potassium to enter the sap from solutions containing 0·00001 *N* potassium. The chloride concentration of the sap remained practically constant. The experiments were performed practically in darkness.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 25

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Sir Charles Bell: "A Recent Journey to Mongolia" (Film).

Tuesday, May 26

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION), at 4.30.—Prof. J. W. Munro: "Insect Damage to Empire Products".

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, LONDON, at 5.—Prof. E. N. da C. Andrade: "Artificial Radioactivity".

WARBURG INSTITUTE, at 5.30.—Prof. Ernst Cassirer: "Critical Idealism as a Philosophy of Culture".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Eugene Schneider: "Recent Developments in Metallurgy and their Influence on Engineering" (Special Lecture).

GRESHAM COLLEGE, Basinghall Street, E.C.2, at 6.—A. R. Hinks, F.R.S.: "On Making Great Telescopes" (Gresham Lectures on Astronomy. Succeeding lectures on May 27, 28 and 29).*

BIRKBECK COLLEGE (NATURAL HISTORY SOCIETY), at 8.—Dr. George Taylor: "The British Museum Expedition to the Mountains of East Africa".*

Wednesday, May 27

BRITISH PSYCHOLOGICAL SOCIETY (MEDICAL SECTION), at 8.30.—Symposium on "Patterns of Culture" to be opened by Prof. C. G. Seligman (joint meeting with the Royal Anthropological Institute).

Thursday, May 28

LINNEAN SOCIETY, at 5.—Dr. W. T. Calman, F.R.S.: "The Origin of Insects" (Presidential Address).

ROYAL VETERINARY COLLEGE, at 5.30.—Prof. L. de Blieck: "Vaccination against Salmonella-Infection".*

CHEMICAL SOCIETY, at 5.30.—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. R. Robinson: "Synthesis in Biochemistry" (Pedler Lecture).

Friday, May 29

ROYAL INSTITUTION, at 9.—Dr. R. E. M. Wheeler: "Current and Forthcoming Archæological Exploration in the British Isles".

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS, May 30–June 2. Annual Conference to be held at Plymouth.

Official Publications Received

Great Britain and Ireland

Technical Publications of the International Tin Research and Development Council. Series A, No. 34: Some Recent Investigations on the Corrosion of Tin. By D. J. Macnaughtan and Dr. E. S. Hedges. Pp. 13. (London: International Tin Research and Development Council.) Free. [204

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 7: Further Studies on Transport in the Cotton Plant. 3: Concerning the Independence of Solute Movement in the Phloem, by T. G. Mason, E. J. Maskell and E. Phillis: 4: On the Simultaneous Movement of Solutes in Opposite Directions through the Phloem, by T. G. Mason and E. Phillis. Pp. 50. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [214

Ministry of Labour. Report for the Year 1935. (Cmd. 5145.) Pp. vi+142. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [214

Annual Reports on the Progress of Chemistry for 1935. Vol. 32. Pp. 527. (London: Chemical Society.) 10*s*. 6*d*. [224

Other Countries

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series, Vol. 21, Memoir No. 3: The Lower Palaeozoic Faunas of the Southern Shan States. By Dr. F. R. Cowper Reed. Pp. xii+130+7 plates. (Calcutta: Geological Survey of India.) 7.10 rupees; 13*s*. [274

Bergens Museums Skrifter, Nr. 18: Die nordischen Munidaarten und ihre Rhizocephalen. Von Prof. Dr. August Brinkmann. Pp. 111+5 plates. (Bergen: A/S John Griegs Boktrykkeri.) 15.00 kr. [284

The National Geographic Society and its Magazine. By Gilbert Grosvenor. Pp. 42. (Washington, D.C.: National Geographic Society.) [294

Proceedings of the United States National Museum. Vol. 83, No. 2982: Five New Genera and Two New Species of Unstalked Crinoids. By Austin H. Clark. Pp. 245–250. (Washington, D.C.: Government Printing Office.) [294

Brooklyn Botanic Garden Record. Vol. 25, No. 2: Twenty-fifth Annual Report of the Brooklyn Botanic Garden, 1935. Pp. 206. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [294

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 12: Availability of Education to Negroes in Rural Communities. By Ambrose Caliver. Pp. iv+86. 10 cents. Leaflet No. 46: Educational Facilities for Children on Federal Government Reservations, 1934–35. By Timon Covert. Pp. 9. 5 cents. (Washington, D.C.: Government Printing Office.) [294

The Egyptian University: Faculty of Science. Report for the Session 1932–33. Pp. 80. Report for the Session 1933–34. Pp. 128. (Cairo: Egyptian University.) [294

Smithsonian Miscellaneous Collections. Vol. 95, No. 4: Second Contribution to Nomenclature of Cambrian Trilobites. By Charles Elmer Resser. (Publication 3383.) Pp. 29. (Washington, D.C.: Government Printing Office.) [294

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 95: Reports of the Proceedings of the Special Plankton Meeting held on May 27th, 1935, at Copenhagen, and of the Special Meeting held at Videnskabernes Selskab's Premises on May 31st, 1935. Pp. 61. 3.00 kr. Vol. 96: Laws and Regulations in Summary concerning Salmon and Trout Fisheries. Compiled by T. E. Pryce-Tannatt. Pp. 37. 2.00 kr. Vol. 98: A Review of Fishery Statistics in relation to Wholesale-Index. By W. Nellemose. Pp. 72. 4.00 kr. Vol. 99: Scientific Report of the North-Western Area Committee for 1933–1935. By Dr. Á. Vedel Tåning. Pp. iii+34+28+20+12+6+20. 4.00 kr. (Copenhague: Andr. Fred Høst et fils.) [304

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 29: Technological Reports on Trade Varieties of Indian Cottons, 1935. By Dr. Nazir Ahmad. Pp. v+116. (Bombay: Indian Central Cotton Committee.) 1.8 rupees. [45

Conseil International des Unions scientifiques. Quatrième Rapport de la Commission pour l'étude des relations entre les phénomènes solaires et terrestres. Pp. 159. (Firenze: Conseil International des Unions scientifiques.) [45

Rensselaer Polytechnic Institute. Catalogue: Undergraduate and Graduate Courses, including those arranged for Officers detailed to the Institute by the Government of the United States; Geographical Distribution of Graduates. Pp. 223+4 plates. (Troy, N.Y.: Rensselaer Polytechnic Institute.) [45

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 39, Part 2: Untersuchungen über die Hyochi-Bazillen im Sake. Von Yoshio Otani. Pp. 49–142. (Tokyo: Maruzen Co., Ltd.) [45

Ontario Research Foundation. Report for the Year 1935. Pp. 31. (Toronto: King's Printer.) [45

Mitteilung der Naturforschenden Gesellschaft Bern aus dem Jahre 1935. Redaktion: Dr. G. v. Büren. Pp. xxxvii+104+5 plates. (Bern: Paul Haupt.) [45

Catalogues

Mandelix (Elixir of Ammonium Mandelate B.D.H.) in the treatment of Urinary Infections. Pp. 8. (London: The British Drug Houses, Ltd.)

Catalogue of Secondary and Higher Text-Books. Pp. 232. (London: G. Bell and Sons, Ltd.)

Eastman Organic Chemicals. (List No. 27.) Pp. 116. (Rochester, N.Y.: Eastman Kodak Co.)

Catalogue of Science and Technology, No. III: Annotated and Classified List of Rare and Standard Works on Exact and Applied Science. Part XII: comprising XIV. Navigation, Naval Architecture and Engineering, and XV. Aeronautics. (No. 846.) Pp. 1193–1268. (London: Henry Sotheran, Ltd.)

Neoket in the Treatment of Urinary Infections. Pp. 16. (Nottingham: Boots Pure Drug Co., Ltd.)